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Forthcoming Events.

MAY 8.

Chemical Society:—Faraday Lecture on "Chemistry and the Quantum Theory," by Prof. Dr. Niels Bohr (For. Mem. R.S.).

Institution of Locomotive Engineers:—General meeting at Denison House, London.

Pulling Together.

A certain studied pessimism has long been recognised as a typically British characteristic. The country is always going to the dogs, and trade is always bad, and even if the foreigner is sometimes misled by the eloquence of our inferiority complex, we ourselves have learnt to take it as a matter of course. Perhaps it is a pity that we have done so; for the consistently gloomy tone of those in authority—politicians, labour leaders, and so on—reacts unfavourably on the minds of those less easily able to think for themselves, and induces a fatalistic acceptance of the "status quo." Nor is the situation improved by that other typically British habit of selecting a scapegoat for our industrial troubles—and a scapegoat that rarely remains the same for any length of time. Indeed, everyone serves his turn in this capacity. There is the Government, stated at monotonously regular intervals to hold the key to prosperity in the form of safeguarding, subsidies, or legislation of one kind or another. There are the big banks, who recently served their turn when the public mind was focussed on the desirability of credit facilities as a first step to trade expansion. There is the old-fashioned directorate, and in particular that all-but-deceased scapegoat, the so-called guinea-pig director. Then management as a whole comes in for attack as out of date and inefficient. These two scapegoats, indeed, the directorate and the management, share the blame in the eyes of the rationalisation and amalgamation experts, and as they also bear the brunt of the attack from the political extremists they are seldom entirely out of the limelight. Then it is stated that there is inadequate technical control in industry, and insufficient scientific research, and alternatively that the research is of the wrong character and in the wrong hands. Or the foreman is attacked: there are people to whom the untrained and unspecialised character of his work is in itself an offence, without the slightest consideration of its essential and invaluable contribution to the industrial machine. While there are other classes that blame the "working man" for every ill that industry is heir to, anathematising trade unions and discounting skill, loyalty and sheer hard work. There are in addition certain inanimate scapegoats that appeal rather less to the public mind because they are incapable of retaliation; among these it is enough to mention obsolete machinery and insufficient mechanical power.

The very multiplicity of scapegoats makes it perfectly clear that no one of them is primarily responsible for the problems of industry. But there is this much truth in the kind of attack we have summarised, that each of these factors has a contribution to make, and that the disaffection of any one is fatal to progress. And by disaffection we do not mean only active opposition but the passive opposition of that ingrained pessimism to which we have already referred. Trade conditions may have been bad of recent years; but are we not expecting too much? Should not the experience of earlier years teach us that trade stagnation is almost a lesser evil than the fantastic prosperity of a boom period, with its short-lived triumphs and its cataclysmic after-effects? It is normal and natural to have to plan and contrive, to solve problems and to face disappointments—provided that everyone concerned realises it, and everyone pulls together.

Destructive Criticism.

We are just a little concerned at a phase of mental outlook which is being evinced increasingly throughout the foundry industry. The attitude of some foundries towards the more striking improvements and developments offered for their consideration can be summed up by the following statement: *The improvement claimed by this process or that piece of apparatus is in no way due to the invention or development but must be ascribed to the metallurgical control which has to be instituted for its prosecution. Moreover, equally good results should be obtainable with existing plants and established processes if scientifically managed.* The insinuation is usually followed up by a reference to some excellent result obtained by some foundry or other.

This argument, boiled down, resolves itself into an insult to the industry in general, as it implies that the mass of the foundrymen are not achieving the best results with the plant, processes and raw materials placed at their disposal.

It is certainly true that a number of recent developments now available to foundry owners do necessitate scientific control of normally loosely-controlled variables, but until exact comparisons can be made, nobody has the right to make such sweeping assertions as have recently and consistently been postulated. The plants and processes which come under this category have presented unimpeachable data capable of being understood and appreciated by any conscientious executive, whilst the quotations put forward by the sceptics can seldom be logically accepted, because the complete conditions are so vague. Some of these unknown conditions are cost, extent of personal supervision, and secret art (rendering continuity of operation problematic and reproduction in other establishments doubtful).

En résumé, we consider this new and disagreeable form of argument unsportsmanlike and unworthy of the best traditions of the industry. Sceptics should bear in mind the fact that the firms exploiting these newer plants and processes are to be numbered amongst the most successful and dividend-paying firms in Great Britain.

XUM

The Poumay Cupola.

At a meeting of the Scottish Branch of the Institute of British Foundrymen, Mr. H. W. Winterton (Branch-President) presiding, Mr. John Cameron, J.P., a past-President of the Institute, read a Paper on the Poumay cupola.

Mr. Cameron introduced the subject by referring to his previous Papers delivered at Falkirk and Paisley. He mentioned that he had received a long letter from M. Poumay in reference to the report of the Paisley meeting.* M. Poumay took exception to the report that he had combined the auxiliary tuyeres of the Greiner cupola and the gyratory tuyeres introduced by Doherty and Blakeney, and had obtained his patent for the combination of these. As M. Poumay had been good enough to go very fully into this matter, giving in addition his views on the reactions taking place in his cupola, Mr. Cameron quoted from M. Poumay's letter as under:—

The Inventor's Theories.

"My system has absolutely nothing in common with the Greiner or any other similar cupola, and the following should serve as proof:—(1) The Paper entitled 'Comparison of the Principle of the Poumay System with that of Previous Regenerative Cupolas,' which appeared over my son's signature in 'Fonderie Moderne,' February 10, 1929, and in which the following passage occurs:—The principle of the systems which preceded the Poumay is as follows:—Burning the CO, that is to say carbon monoxide, to make carbon dioxide, CO_2 ($CO + O = CO_2$), the formation of which in the cupola is *beyond the control of the inventors.*"

The principle of Poumay is as follows:

Burning the CO to make CO_2, that is to say, burning the carbon monoxide, the intensive formation of which in the melting zone Poumay deliberately promotes. The systems which preceded the Poumay considered the presence of CO as a defect which they tried to remedy. Poumay considers it as an ally and favours its formation. Earlier processes worked exclusively above the zone of fusion and brought about in the charging column the sole reaction $CO + O = CO_2$.

Poumay works:—(*a*) *Below the Zone of Fusion*, making the following successive reactions:—(A) (1) Transformation of CO_2 into CO by two successive reactions taking place by virtue of the presence of incandescent coke (A) at the level of the tuyeres $2C + C = CO_2$. This CO_2 when it rises encounters the incandescent coke and is transformed into CO, that is to say (B) $CO_2 + C = 2CO$; (B) (2) transformation of CO_2 into CO under the influence of the high temperature in two simultaneous reactions. (C) $CO_2 = CO + O$. The atom of O coming from this reaction is immediately allied with an atom of C and gives (D) $O + C = CO$.

(*b*) *Above Zone of Fusion.*—The CO coming from the above-mentioned reactions beneath the melting zone, which are deliberately encouraged, is burned by the regenerative tuyeres following the reaction:—$CO + O = CO_2$.

Then follows a study in which my son deals with the questions of temperature, oxidising tendency of cupolas, multiple melting zones, fractional combustion of CO. All these factors, added to the radical difference in the principles of working make it impossible to confuse the Poumay system with any other system of regeneration whatsoever. Far from merely combining old ideas (auxiliary pipes and tuyeres to give the air a gyratory motion), I set out from an entirely different principle of the working of the cupola (entirely new, and what is more, hitherto avoided by everyone, being considered an indication of bad combustion and of poor calorific and economical return in the cupola), that is to say, the deliberate and intensive formation of CO in that part of the cupola between the base and the highest level of the melting zone (which is the upper limit of the oxidising region of the cupola), and the ultimate combustion of the CO allows us to obtain the whole of the heating power of the coke and the best economic yield of the cupola. The phenomena of combustion in the Poumay cupola are not analogous to those which take place in all other cupolas, including the Greiner, or in any similar apparatus, and the tuyeres have special functions to fulfil, leading to the final aim. On the other hand, I do not know of any cupola which has tuyeres with two branches, as stipulated for my preparatory (second row) tuyeres (radial and tangential). As for the Greiner system or any other, I do not believe you have ever seen one that has, like your own cupola modified on my system, three helicoidal rows of tuyeres of regeneration. For bigger cupolas it is possible to have four, five and even more; this is decided by the study that must be devoted to any cupola prior to the application of my process.

A German View.

(2) You should also read the Paper entitled "Der Kupolofen nach Poumay," which appeared in "Die Giesserei," Vol. 33, August 17, 1928, pp. 816 to 819, over the signature of Prof. Dr. Ing. C. Geiger, Oberesslingen, in which he clearly states: "As far as the construction itself is concerned, it resembles at first sight the Greiner and Erpf system which was known in 1800; actually it differs considerably in some remarkable ways. It also incorporates certain ideas of Inneland, Voisin and Hamelius.

"Greiner and Erpf began with the idea of burning distinctly the CO coming from the reduction of the carbon dioxide, according to the equations:—$CO_2+C=2CO$ (39,180 calories); $2CO+O_2=2CO_2$ (135,920 calories). Four tuyeres placed at the wind box served for melting, while a quantity of smaller tuyeres disposed propeller-wise around the cupola to within one metre of the mouth, brought air for the burning of the CO. In practice it was found that, as soon as the regenerative tuyeres entered into activity, the coke began to burn on account of the great heat given off by the combustion of the CO. In most favourable cases, that is to say, when these small tuyeres were opportunely put out of action, the coke—very much heated, incidentally—still reached to the melting zone, where it provoked a bad relation of combustion. By its profile, which narrows towards the mouth and has a bulge which narrows before it reaches the melting zone, it reminds us of the profile of the blast furnace. The cupola has two ranges of tuyeres at the wind belt at a distance of 20 to 30 c.; the regenerative tuyeres are arranged in three spiral rows reaching from the upper part of the bulge to 1.5 metres or 2 metres higher. The result of this is that, contrary to the Greiner cupola, which only receives air from one side in the regions of the burning of the CO, the cupola receives air from three sides in the region of regeneration and on every level. Poumay succeeds where the tests of Greiner and Erpf fails; he gets there by an entirely different route, for, by the placing, the number, the form and the arrangement of his tuyeres he deliberately aims at incomplete combustion in the lower part of the cupola beneath the zone of fusion, and he thus avoids the presence of free oxygen and an oxidising atmosphere in the cupola. As regards the regenerative tuyeres, Poumay declares that they serve to burn the CO into CO_2, but the aim is not by any means the same as that of Greiner and Erpf; the fractional combustion of the CO serves to heat the descending charges and to obtain thus a higher temperature for the cast iron. *The desired end, namely, to provoke incomplete combustion in the lower part of the cupola and so to avoid oxidation in the melting zone, is a definitely new and special principle.*"

British Steel Founders' Opinions.

Mr. Cameron also announced that he had received some notes by Mr. J. Deschamps, managing director of Messrs. Kryn & Lahy, the consultant to the agents, which would also prove interesting.

The "Poumay" System aims at:—(1) Obtaining the highest possible percentage of CO_2 in the escaping gases and the lowest possible percentage of CO in those gases, and (2) obtaining the lowest possible percentages of CO_2 and free oxygen in the gases passing through the zone comprised between the level of the melting tuyeres and the upper level of the melting zone.

Instead of getting, as is the case in an ordinary cupola, $C+O_2=CO_2$ *under* the melting zone, one gets, in a Poumay cupola, $C+O=CO$ under the melting zone, and the drops of iron have, therefore, in a Poumay cupola, to traverse a zone of reducing atmosphere before reaching the well of the cupola, whereas, in an ordinary cupola, the drops of molten iron have to pass through an *oxidising* atmosphere, because, at the temperature existing between the melting tuyere level and the melting zone, the following reactions take place:—

$CO_2=CO+O$.
$CO_2+Fe=FeO+CO$.
$O+Fe=FeO$.
$O_2+Si=SiO_2$.
$O+Mn=MnO$.
$O+C=CO$.

The beneficial effect of this reducing atmosphere under the melting zone of a Poumay cupola is proved by the fact that the slag obtained from a cupola working with the Poumay System contains usually less than half the amount of iron oxide present in the slag ex an ordinary cupola.

It is also proved by microscopical examination of the metal, which shows considerably less gas-holes and impurities than is the case with an ordinary cupola.

Many people assume that they are working as economically as possible, with an ordinary cupola, when no flames appear at the charging-door level. It must be borne in mind, however, that the absence of flame does not necessarily mean that no combustible CO is present in the escaping gases. It simply means that these gases are too cold to enable the CO they contain to burn in contact with the air entering through the charging door.

In case of a complete absence of flame only the chemical determinative will show whether this is due to the absence of CO. Therefore, over and above the reduction in coke consumption, the Poumay cupola offers the following important advantages:—(1) Absence of oxidation in the most important zone of the cupola, *i.e.*, between the melting zone of the level of the melting tuyeres; (2) reduction of the S-content of the molten metal; (3) increased rate of melting; (4) cleaner metal; and (5) reduced loss of Si and Mn.

Effect of Rational Combustion.

In the annual syllabus of the Scottish Branch a few years ago there were included a few pages of definitions and data, in which it was pointed out that 1 lb. of carbon burned to CO developed 4,320 B.T.U.; 1 lb. of carbon burned to CO_2 developed 14,540 B.T.U.; and 1 lb. of carbon (in carbon monoxide) burned to form CO_2 gas developed 10,220 B.T.U.

From these figures it appears that to get the maximum heat value from the coke the carbon of the coke must be burned in air to CO_2, as CO only yields one-third the heat given out by CO_2.

There is no doubt that in an ordinary cupola the reactions can be varied by different means, *i.e.*, quality of the coke used, shape of tuyeres, pressure of blast and quantity of air blown into cupola. Mr. F. J. Cook has postulated he can

* Foundry Trade Journal, March 21, 1929.

get soft and hard iron from the same cupola by varying blast pressure. Dr. Piwowarsky and others have pointed out that for each individual cupola there is one correct blast volume, coincident with the most efficient CO_2 : CO ratio.

All foundrymen aim at a reducing atmosphere, and are in agreement that for normal foundry work an oxidising atmosphere should be avoided. This is obtained in cupolas with tuyeres of the Whiting type by having a large tuyere area and admitting the air under lowest possible pressure to ensure its reaching the centre of the cupola. In this form of cupola, personal experience favours one row of tuyeres splayed as much as the diameter allows, and in M. Poumay's letter he agrees with this.

"In every ordinary cupola the best working is obtained with a single row of tuyeres. In an ordinary cupola the second row merely results in (*a*) an increase in the height of the melting zone; (*b*) a consequent increase in the oxidising zone, and so a loss by oxidation of Si, Mn, C and Fe; (*c*) loss of quality in the metal in the furnace; and (*d*) bad quality of the metal obtained.

"The flame at the mouth depends solely on the possibility of ignition and the presence of CO at the mouth. There is always CO there (and in considerable quantities in a properly-run ordinary cupola, for if there is little it is a sign of bad running), but if the mixture resulting from the rising gases and the air at the mouth is not at ignition temperature, there will be no flame at the mouth. That does not mean that there is no CO, and before now I have seen men fall unconscious, asphyxiated by CO, on the charging floor of certain cupolas where there were no flames at the mouth. It is easy enough to avoid the flame, but to avoid the presence of CO in these gases is quite another matter. No ordinary cupola can do it; the Orsat apparatus will convince everyone of this and of the proportions."

Poumay's design seems to be in opposition to the above principle. His tuyeres are of small area, the ratio inclusive of regenerative tuyeres being about 11 to 1 in a 54 in. dia. cupola. The pressure of blast is also high.

When a start was made with the Poumay cupola there was some apprehension that these features might tend to give some of the troubles due to an oxidising atmosphere, particularly in some of the castings with very thin sections. Two years' experience, however, has proved that these apprehensions were unnecessary. No troubles or losses have transpired in these respects.

Some Factors influencing Cupola Melting.

Dr. Hay,* in addressing the Falkirk Section last year, drew attention to the quality of the coke, particularly in regard to its ash content. He had taken table No. VI from this report. While this table gives figures for blast-furnace practice, Dr. Hay points out that though not strictly applicable to the cupola, the moral is the same.

There is also the question of moisture in the coke. This varies considerably according to weather conditions, particularly if coke is stored in the open air. A considerable amount of water can be absorbed by coke, and when this is present a good deal of heat is used to drive out the moisture.†

At present the author keeps the coke in the open air, but daily records show that the best results, as regards economy of fuel, are obtained in the summer months.

Prof. Campion has pointed out also the effect of variations in the blast supply due to dry and to damp weather and the state of the barometer.‡ There are also the differences of structure and composition between varieties of coke used, *i.e.*, Welsh, Durham and Scottish, each giving different results. The kind of iron melted has also to be seriously considered, as high-phosphorus iron as produced in the Middlesbrough district takes less coke than hematite, or semi-steel mixtures. The factors mentioned above account to a large extent for the variations of cupola-working from day to day.

* Foundry Trade Journal, May 30, 1929.
† See Paper by W. H. Poole. I.B.F. Proceedings, Vol. XXI, p. 610
‡ I.B.F. Proceedings, Vol. XX, p. 92.

Performance Detailed.

Illustrations of the cupola and the following tables were shown on the screen. Table I shows comparative coke consumption before and after alteration:—

Table I.—*Comparative Coke Consumption per cent of Coke used to Metal Melted, excluding Bed Charge in each case.*

Before conversion to Poumay type (54-in. diameter).	After conversion to Poumay type (51-in. diameter).
	Per cent.
	6.74
	6.67
	6.57
Approximately 10 per cent.	6.34
	6.46
	6.73
	6.66
	6.76
	6.61
	6.74
	6.63 average.

Table II shows comparative tapping tests. These figures were taken on monthly averages:—

Table II.—*Comparative Tapping Rates in Construction. Diameter of Cupola at Melting Zone, 54 in. before conversion, 51 in. after conversion.*

Before conversion.	After conversion.
Tons per hour.	Tons per hour.
10.7	12.8
10.75	12.85
10.0	13.45
10.9	12.9
10.2	12.95
10.3	13.05
10.8	13.2
10.5	13.1
10.3	12.95
10.7	13.0
Average 10.52	Average 13.03

Table III shows almost total combustion of the CO gas from samples taken at level of charging door.

Table III.—*Analyses of Cupola Gas Sample taken a Charging Door.*

Carbon dioxide.		Oxygen.		Carbon monoxide	
Before alteration.	After alteration.	Before alteration.	After alteration.	Before alteration.	After alteration.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
12.3	18.0	0.4	0.2	10.5	0.15
13.0	17.6	0.2	0.4	10.1	0.10
12.7	18.4	0.4	0.7	10.9	0.10

Table IV shows comparative metal temperatures. The readings do not profess to give actual temperature, as they were taken by optical pyrometer.

Table IV.—*Comparative Metal Temperatures. Average Readings taken every ½ hour of run in each case.*

Ordinary cupola temperature deg. C.	Poumay cupola temperature deg. C.
1,291	1,339
1,333	1,340
1,320	1,352

Table V shows reduction in sulphur content.

Table V.—*Sulphur Content of Metal Tapped on Consecutive Days from No. 1 Cupola and Poumay Cupola.*

No. 1 cupola.	Poumay cupola.
0.069	0.041
0.073	0.059
0.064	0.055
Average 0.068	Average 0.052

Difference, 0.016.

Table VI shows effect of ash content of coke as referred to in Dr. Hay's Paper.

Table VI.—*Cost Increase with increasing Coke-Ash Content.*

Per cent. ash in coke.	Extra cost in pence per ton of iron produced.
5	—
6	16.83
7	34.44
8	52.90
9	72.28
10	92.62
11	114.02
12	136.56

General Desiderata.

Mr. Cameron proceeded to deal with other features which had been frequently inquired about in correspondence and also by questions at meetings.

Small Cupola.—M. Poumay states that his cupola is working in all dimensions yielding from 1 ton to 25 tons per hr. The economies effected are greater in the smaller diameters, as the ease of reaching the centre with the blast means a lower percentage of coke.

Melting Semi-steel.—The Poumay cupola is admirably adapted for melting "semi-steel." This had been proved at his own works. Messrs. Kryn & Lahy, Limited, of Letchworth, stated with reference to a mixture of 75 per cent. steel scrap and 25 per cent. hematite pig, that the fusion coke percentage had been reduced to 9 to 9½ per cent. in a Poumay cupola; a reduction from 13 to 14 per cent. before the cupola was transformed. They found the resulting metal quite as hot as before, associated with a considerable reduction in sulphur and faster melting.

Cupola Lining.—The practice, before converting the cupolas, was to re-line the area of the melting zone every six months. With the Poumay this period has been extended to nine months. In some cases the tangential openings in the upper row of tuyeres may require adjustment, should undue wear of lining appear. This is provided for in the design. In our own experience, these have not required to be touched.

Recovery from Bed is normal and found to be the same as an ordinary cupola. The amount of coke recovered depends to a large extent on the quality of the fuel. The better and harder the coke in the bed, the greater the recovery.

Tuyere Area.—In a 54 in. diameter cupola before alteration, the ratio of tuyere area to cupola area was 1 to 5.6. In Poumay cupola of the same diameter the ratio of the two rows of bottom tuyeres to furnace was 1 to 13, and, including the auxiliary tubes, the ratio was 1 to 11.

Coke in Bed.—The amount of coke in bed was 22 cwts.

Loss of Metal.—The slag has been tested from time to time, giving the following average results:—FeO in ordinary cupola in slag, 4.38 per cent., and in the Poumay cupola slag, 3.66 per cent.

In summing up, Mr. Cameron mentioned that he had carefully watched cupola practice in many countries and had seen many varieties in operation. In most countries, 10 per cent. of fusion coke was considered a fair average. In his experience, the Poumay cupola was the most efficient and economical he had seen. It was not

(*Continued on page* 340.)

Making a Press Follower from an Old Casting.*

By A. Sutcliffe.

The press follower shown in Fig. 1 was made from an old casting which had cracked in use; the casting is 7 ft. long, 4 ft. wide and 21 in. through and the weight is 4 tons 1 cwt. There are four large holes at each end, for which cores were made and placed in the pattern and lifted with the top box. Core boxes were made for the other cores required; there are 3-in. holes on the top of each side core, and these are the outlets for the side cores, bolting and vent. The four cores round the centre boss are bolted back in their prints. The centre core is in four pieces; 2 in. from the print is for facing and 2 in. print forms a 4 in. deep solid round piece of core for the four pieces to join to. The grid for this core is out of the ordinary, as it is made from a blank flange and four pieces of old core barrel cast along with eight pieces of wrought-iron rods; these keep the core quite firm. The flange has also two threaded nuts cast in for bolting back in the top box.

First of all a level bed is made, 6 in. above a bed of cinders, and is sprigged with 2-in. sprigs about 2 ft. up the bed in front of the runners, four pieces of timber are cut 3 ft. 10 in. long,

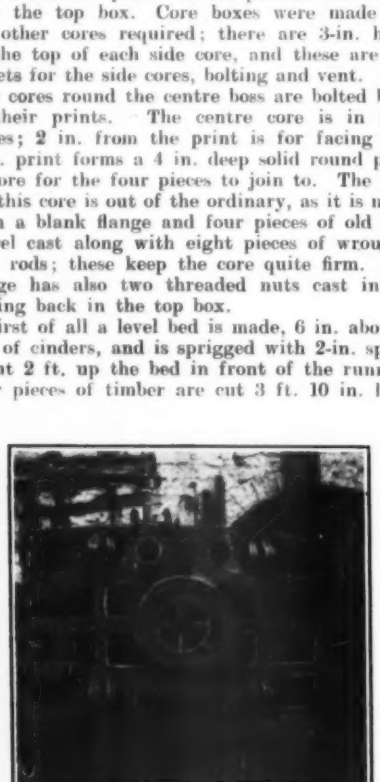

Fig. 1.—The Press Follower made from an Old Casting.

12 in. wide and ½ in. thick, which are laid on the sand bed, and then the pattern is placed on the top, which makes allowance for machining and holds the pattern up whilst being rammed up. After ramming up and making the joint, the eight square cores are placed in the pattern, the holes four at each end, the other holes being plugged up, and prints on. It must not be forgotten to place back scotches on both prints and cores to prevent them being pulled through the box bars, also when bolting the cores back it must be remembered that these cores are 18 in. deep, and as the box has to be turned over with them bolted back, the cores must not slip in any way. The top box is 11 ft. by 8 ft., and when finished and all the cores are on it would appear that all the job is on the top part. The next thing to do is to draw out the pattern or old casting from the bottom of the mould; it must not be expected to find any taper in the casting used for the pattern, but the best must be done under the circumstances. The moulder now finishes the bottom and makes it ready for receiving the metal. The top box is then tried on without a crush, and the casting should then be found to be a success. All the vents should be quite clear, and if they are not the casting will be a failure. Only a small amount of patternmaking is required; *i.e.*, three core boxes, the holes plugging up and prints put on the old casting with two contraction pieces at each end.

* Part of a Paper read by the Author before various branches of the Institute of British Foundrymen.

Recent Launches.

Messrs. Harland & Wolff, Limited, launched the single-screw motor cargo vessel, "Alfred Jones," built to the order of the British & African Steam Navigation Company. The vessel has a gross tonnage of 4,020, and the propelling machinery consists of single-acting, eight-cylinder, airless-injection engines of the Harland-Burmeister and Wana type.

Ailsa Shipbuilding Company, Limited, have launched from their Troon yard the steamer "Orchy," built for Messrs. William Sloan & Company, Limited, Glasgow. The "Orchy" is intended for coastal work in general cargoes, and is of 1,200 tons deadweight. The builders are supplying the propelling machinery, a set of triple-expansion surface condensing engines.

Messrs. D. & W. Henderson & Company, Limited, launched the cargo steamer "Prestatyn Rose," built for Messrs. Richard Hughes & Company, Limited, Liverpool. The machinery consists of triple-expansion engines supplied with steam at 180 lbs. pressure from two natural-draft, single-ended boilers.

Messrs. Henry Robb, Limited, Leith, have launched the twin-screw motor vessel "Katherine II," constructed to the order of the War Department. The vessel is 120 ft. in length, and has been designed for general cargo service at Woolwich Arsenal. Motor engines of 300 b.h.p. are to be installed by the builders.

The Burntisland Shipbuilding Company, Limited, launched a vessel built to the order of Messrs. Glen & Company, Limited, Glasgow. She has been constructed to a very high-class specification and is fitted with the latest type of deck machinery and discharging gear. The vessel has a deadweight carrying capacity of 2,680 tons, and the propelling machinery will be supplied by the North-Eastern Marine Engineering Company, Limited, Wallsend.

Messrs. Workman Clark (1928), Limited, Belfast, have launched the twin-screw motor cargo-ship "Taybank," for Messrs. Andrew Weir & Company, Limited. The vessel is of 5,000 tons gross and will be fitted with twin sets of Sulzer-type engines constructed by the builders.

The Poumay Cupola.

(*Continued from page* 339.)

so elastic as the ordinary design. It called for facilities for weighing exact charges of coke and metal, and a good volume-meter was essential, but these, after all should be available and used, no matter what cupola was used.

A little practice was required to get and maintain throughout the heat the best results, and when this was found it became ordinary routine work to ensure regular and consistent results.

It seemed to him from the figures given in the tables, the analysis of the slag and general results that M. Poumay's claims, particularly as regards economy, fast melting and a non-oxidising atmosphere, were well established. He had no interest in the cupola and only desired to give the members of the Branch his actual experiences and opinion of the Poumay cupola. He concluded by stating that if any point had not been put clearly enough, he would be glad to answer any questions.

(*To be continued.*)

Random Shots.

I recall when I was in Germany last year noticing a number of apparently derelict works in the Duisberg-Düsseldorf district, and being obvious from the various laments that rationalisa- In theory it sounded all very fine—half-a-dozen plants had been amalgamated, the processes specialised, and the least efficient unit simply scrapped. But in practice I couldn't help wondering what had happened to the men whose livelihood depended on that "least efficient unit," and what had been the fate of the village that had in continental fashion grown up around it. . . . That other people have from time to time wondered something of the same sort is obvious from the various laments that rationalisation will mean increased unemployment, and so on—you have all seen them. And now the question has been given prominence by the resignation of Mr. Angus Watson from the firm that bears his name. The industry concerned is not one that touches us very closely, though most of us have eaten Skipper Sardines. But the question itself touches us closely, or will do soon enough.

* * *

The reason was stated to be, if I remember rightly, the control of the staffs of individual firms by the directorate of the amalgamation. In other words, it was a protest against the submission of humanity to efficiency. It is obvious that the rationalising process, if it does not directly increase unemployment, must cause a good deal of temporary displacement and transference. This is bad enough in itself, but if care is not taken that the right men—or rather, the wrong men—are displaced and transferred, the evil will be immensely augmented. Most of us could cite men amongst our own friends whose jobs have shrunk up or disappeared for no other reason than that the firm has been taken over, or amalgamated, and the staff of the dominant firm has automatically taken charge. It was, I imagine, as a protest against this kind of disregard of personal factors that Mr. Watson took the step he did.

* * *

I don't want to appear hostile to the rationalising process: it is, I firmly believe, absolutely essential to our industrial rehabilitation. But it is not nearly as straightforward a business as the enthusiasts would have us believe. We are not Robots yet, after all. We do still think and feel. The consolation and the hope lies in the fact that thinking and feeling is common to all ranks in industry. The business man likes to be thought as hard as nails: but some business men would not be much use to the carpenter in that capacity!

* * *

A certain provincial paper has been collecting samples of what it describes as "Cookery French," although there have been just as many cases of "Cookery English" among them. Those of us who have been abroad have all met "rosbif" and "biftek," and some of us have even encountered "Irish stew à l'Anglaise," but we cannot all cap the experience of the gentleman who complained that his "rosbif" was veal, and was told quite calmly: "Ah, oui, m'sieur, c'est le rosbif de veau." Against which another correspondent set the case of the English restaurant—*not* a fashionable one!—that served fried cod as "sole Colbert." When the fussy visitor objected to this the waitress said conclusively: "Oh, well, it's what *we* call sole Colbert, anyhow!"

Marksman.

French Foundries near Paris Visited.

The London Junior Section of the Institute of British Foundrymen held its annual general meeting at the offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, W.C.2, on April 25, Miss M. D. Pittuck presiding.

Election of Officers.

Miss M. D. Pittuck was elected chairman for the coming session, with Mr. L. H. Howell as vice-chairman. Mr. P. Ellis was unanimously re-elected hon. secretary, whilst the following were appointed to serve on the Council: Messrs. B. B. Kent, J. Butler and F. Perry.

On the motion of MR. HOWELL, seconded by MR. PERRY, a hearty vote of thanks was passed to the retiring chairman, Mr. H. R. E. Slater, and his officers for their work during the past session. A special vote of thanks was accorded to Mr. P. Ellis, under whose secretaryship the Junior Section had made admirable progress during the past session.

The retiring chairman, MR. H. R. E. SLATER, proposed a very hearty vote of thanks to the proprietors of THE FOUNDRY TRADE JOURNAL for their kindness in again lending their room for meetings. This was a privilege which the Junior Section greatly appreciated, and he would ask the secretary to send a letter thanking them on behalf of the members.

Votes of thanks were also passed to Mr. V. C. Faulkner and Mr. H. G. Sommerfield for their continued interest in the work of the Junior Section, and also to Mr. Butler for his services.

Summer Outing.

It was decided that the members should have a social outing during the summer months, the arrangements for which were left in the hands of a committee consisting of Miss Pittuck, Mr. Howell and Mr. Sherman.

After the business of the meeting had been completed a short Paper was read by MR. B. B. KENT, who, with a party of members of the Institute, recently visited Paris.

Impressions of French Foundries.

Perhaps the most outstanding features of foundries and works generally in France are the abundance of work, the apparent absence of factory regulations and "red tape," and the presence of women in industry. The total unemployment figures for the whole of the country at the end of March was 12,419,* which figure is all the more remarkable in view of the fact that a large percentage (estimated at about 15 per cent.) of workers are either women, foreigners, or coloured people.

Women are engaged in every phase of foundry work except that of actual metal-carrying, which in several cases is done by negroes, whilst core-making, by both hand and machine, is always carried out by female labour. Juvenile labour is much in evidence, the age limit being as low as 13 years, and works abound with miniature workpeople of about 4 ft. in height.

As regards Government regulations, belt guards, protectors round grindstones, and similar precautions, are conspicuously absent, and the favourite means of fixing electrical gear apparently is string and nails; this does not only apply to works, as outside installations on buildings are similarly erected.

The workpeople generally work much harder than in this country, that is, when on piecework, but the general labourer appeared to be in no hurry at all and invariably worked in carpet slippers! On inquiry it was learnt that a moulder can earn about 300 fcs. (£2 10s.) per week, but his hours of work are longer than in this country.

Generally, foundry conditions and equipment are much the same as in this country, with one or two exceptions. Ladles, for instance, are lined and finished with a pouring hole by which the metal is poured from below the surface, thus obviating skimming the dirt from the iron. Foundry sand in France is, on the whole, poor, which explains the great pains taken in sand preparation and the elaborate plants installed in the foundries. There are quarries within a few miles of Paris, but the sand appeared to be very uneven and was like clay when wet. As regards plant, it was noticed that many machines, such as lathes, drills, and cupola fans, were of British manufacture.

An Unusual Cupola.

The first works visited was Messrs. Ph. Bonvillain and E. Ronceray at Choisey-le-Roi, manufacturers of moulding machines, cleaning plants, and patent pulley blocks. Although the visitors were told that the foundry could only be considered as an experimental one, much of interest was to be seen. The cupolas were of an unusual type, the brickwork terminating at the charging platform, whilst the remainder of the height was composed of a lined metal screen. These works were constructed on two levels, so that the cupola "stage" actually was ground level and the foundry floor was about 10 to 12 ft. below. This cupola was fitted with a "syphon brick" which enabled metal to be drawn off in any quantity at a time without the necessity of tapping and botting up each time. To obtain the metal, a handle similar to that of a pump was lowered and released again when the ladle was full.

Moulding machines both in course of construction and in actual use were seen. One machine particularly interested the party, and it was worked by a girl who produced 230 moulds per day, using one box, *i.e.*, stripping the box on a specially-constructed apparatus alongside. At this point it might be mentioned that hydraulic power seemed to be preferred to pneumatic, although no particular advantage was claimed.

All the cores in this works were prepared with sea sand and a composition of the firm's own manufacture which enabled them to be used immediately, thus obviating the necessity of core ovens and saving considerable time. Members of the party were invited to mark a core and were shown a perfect casting produced within a very few minutes.

Paris Foundry High School.

The afternoon was spent inspecting the Foundry High School in Paris, a wonderfully-equipped institution, organised regardless of expense. At the time there were thirty foundry students and thirty-two professors! The pupils, including one girl, were of all nationalities, with the exception of British; the visitors were informed that the school had never had any of our own countrymen as students. Although we have no *one* institution so perfectly equipped in this country, it must be remembered that it is the only one in Paris, while we have several in London which, if all were brought together and combined, would compare very favourably.

A steel foundry was visited the following day at Vitry-sur-Seine where railway brakes and equipment, sand-blast nozzles and miscellaneous steel castings were produced. Two cupolas were in operation, with two Bessemer converters to produce the steel. The sand in this case was an oil sand delivered by overhead conveyors to the moulding machines. Some surprise was caused by the great hurry in which the castings were removed from the sand, and frequently the sand was returned to the mixers when nearly incandescent.

The Renault Works.

The next works to be visited was that of the Renault Motor Company at Billarcourt, situated on both sides of the River Seine about two miles from the outskirts of Paris. Some idea of the vastness of these works can be obtained from the following statistics. There are more than seven miles of railway track (private sidings) inside the works, while the company have built a private bridge across the river to connect that portion of the works on the south bank. This bridge is a ferro-concrete structure suitable for the heaviest of traffic. Although there are five works in all, situated at Billarcourt, Clichy, Saint-Denis, Mans and Acton, this works is the largest and employs the major portion of the 37,000 hands. The extent of all their factories covers an area equal to the town of Chartres or, say, Epsom or Chelmsford.

Continuous-Casting System Used.

The first portion of the works to be visited was the aluminium foundry, the metal being melted in a number of oil-fired furnaces. This foundry, like that of Citroën (visited later), employed the continuous-casting system. The moulds, all machine-made, were placed on a moving conveyor. The mould was then sprayed with blacking from a gun and, after passing metal pourers, moved to a grating where the castings were dragged out, while the sand dropped into the grating and so passed back to the sand-reconditioning plant. The castings were then removed to the fettling shop and were sand-blasted by being placed on an endless belt passing through a housing containing the nozzles.

The brass, iron and steel foundries were next visited, most of which were casting on the continuous-moving conveyor system. A machine worthy of mention was seen in the aluminium foundry producing parts for carburettors. The molten metal was forced into the dies and produced castings at the rate of 1,200 per hr. There were two or three of such machines, each being attended to by men.

The time for tapping out was announced by warning notes on a Klaxon horn, at the sound of which scores of men lined up and held ladles under the spout, actually running to the moulds on their ladles being full. At the end of this foundry the core ovens were situated, each controlled from a central point. Not only was the operator able to tell the exact temperature in each furnace by electrical-recording instruments, but the temperature at different points in each oven was also registered.

Other portions of the works were visited, including the die-stamping, painting, erecting and testing shops. Although not of direct interest to foundrymen, the method of erecting cars deserves special mention. A number of slow-moving chains are attended by some dozens of assemblers working in fours, who have a specific job to do as the partly-assembled chassis passes their position. First the chassis sides were placed on the chain and the rear springs assembled. By the time this was finished the car had moved to the next set, who assembled the axles, etc. Later the motor was lowered into position, and after testing this, the brakes and tyres, the body was also swung on the chains. Eventually the final polish was given to the paintwork and windows, and the car left the chain by its own power *en route* for the stores and showrooms.

Citroen Foundries.

The Citroën works, visited on the following day, was producing castings only, the machine and assembling departments being at Issy. There was a certain similarity between the Citroën and Renault works, but it was noticed that the speed of production was higher than the Renault, whilst a large proportion of the workpeople were foreigners.

The foundries were on three floors, the metal being brought up to each floor in large containers and sent down each shop by means of an overhead track, the driver sitting on a seat behind the container. The core-assembling also was done on moving conveyors, while in some instances even the machines at which a man was

(*Continued on page* 342.)

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* The total for Paris alone on April 12 was 7,142 while there were 3,586 vacancies.

Making a Foundation-Base Casting.*

By H. Sutcliffe.

In the making of a foundation-base for a paint mill (Fig. 1), two had to be made off one pattern in as short a time as possible, and as the price had also to be keen, everything had to be made as well and cheaply as possible to ensure a profit on the finished casting. The job is 7 ft. 6 in. long, 4 ft. 6 in. deep, and 4 ft. wide, with panels at the ends, two on each side and two top and bottom. These panels make the job slightly risky, as they are liable to cause cracking when cast.

A level bed should be made on which to place the pattern. It should be 6 in. above the cinder bed, this being 5 ft. down in the foundry floor

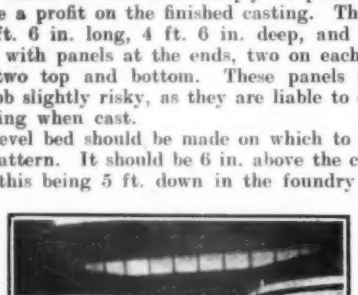

Fig. 1.

from the top of the cinder bed. The job can now be rammed up in the ordinary way, special notice being taken that the job is rammed harder at the bottom than a 2-ft.-deep job would be, as there is a much greater strain with 4 ft. 6 in. deep. The job should be run at the bottom flange by two flat inlet runners. The pattern, it will be noticed from Fig. 1, is like a plain block having no prints to form the panel-holes, these being formed in the body core-box, thus ensuring a straight ram. Half-way up the pattern a vent should be put into the cinder bed, and then the moulder can ram up again to the

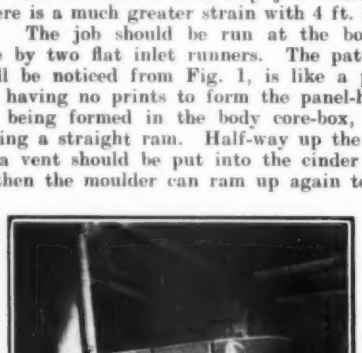

Fig. 2.

top of the pattern. With this depth to be rammed, three rows of irons are necessary. The top joint should then be made and the top-box rammed up and lifted off.

It is taken for granted that a small rut has been cut all round the pattern about 3 in. away. For the top half of the vents this small rut should be filled up with wet parting-sand just before putting on the top-box, and the other half of the vents should strike in the coke bed, that is, those which were put in half-way up the pattern during ramming. The pattern should then be drawn out; this should come out very cleanly, as it is quite a plain job, having no corners or prints.

There is very little finishing to be done here, except to wet-black, put two bucket-fires in the mould, and cover over with tins, which makes the job appear like a small stove. It is immaterial whether or not the top is dried, as there is only 6 in. of metal flange all round, the panel cores being in the centre, just forming a 6-in. rib in the centre bar. The mould now being dry, can be cored up with all the cores. The cores used were made in Glyso, and were very firm to handle.

The core-boxes forming the panel cores (Fig. 2) should be half-size in each case—top, bottom, two ends and sides. The body should be made out of an eighth part of the core-box. The panel core should be fastened into two of the bottom cores and laid on the bottom panel cores. The panel cores on the side give the thickness against the wall of the mould. The two body-cores should then be put in, keeping them against the two already in, the remainder of the panel cores —end and sides—should now drop into their prints of the body cores.

Half the job should now be cored up, the same method being followed in the top half of coring, except that the panel cores this time should be against the wall of the mould, and the body cores slid over them. The top panel cores should then be laid on the top of the body cores, thus all the air will come through these and through the top box. There are no chaplets or studs required for this mould, as the panel cores set and hold all cores in place and give a true thickness.

* Part of a Paper presented to various branches of the Institute of British Foundrymen.

French Foundries near Paris Visited.

(*Continued from page* 341.)

working moved, it being necessary for him to manœuvre himself to keep in the correct position to operate it.

On the same afternoon the aluminium foundries at Montupet were visited, the journey being made by motor-coach through the Forest of Chantilly. Most of the work done here was of a nature that did not permit of special machines such as those seen at the motor foundries, but their sand-reconditioning plant was of unusual design and worked very effectively. The principal metal used was either Alpax or Calypso, containing about 8 per cent. Si, which was used for numerous kinds of castings, including railway doors, automobile engines, motor-car bodies and fittings.

The party then proceeded to the works of either Massey-Harris, of Lille, or the International Harvester Company at Croux, near Lille, on the following day, but the writer visited the works and foundries of Alfred Baillot & Company at St. Ouen, near Paris. Here foundry equipment of nearly every description was seen either being tested or in the course of construction, including sand millers, disintegrators, and complete sand-preparing plants. One of the latter was demonstrated and could deal with 20 tons of sand per hr. These plants were of the same make as seen by the party visiting Massey-Harris Company at Lille.

There were, of course, scores of small details seen at each foundry which were especially interesting to individual members of the party, but the short description given concerns matters of general interest only.

Mr. Kent was cordially thanked for his Paper, and the meeting closed.

Messrs. Thos. W. Ward, Limited, Sheffield, have acquired from the Nelson Line three vessels which have been laid up in the River Tyne for many months. They will be broken up at Barrow. The vessels are the "Highland Star," "Highland Watch" and "Highland Heather."

General Meeting of the German Foundry Technical Association.

On May 24 and 25 of this year the German Foundrymen's Technical Association will hold its 20th annual general meeting in the reception rooms of the Zoological Gardens. In the forenoon of the first day visits will be made to the iron and cylinder foundries belonging to the Firma Otto Jachmann A.G. and to the non-ferrous foundry of Siemens-Schuckertwerks A.G. The first meeting will then take place in the afternoon of the same day in the banqueting hall of the Zoological Gardens, and the following Papers will be given:—

(1) "High-Strength Cast Iron and Eutectic Iron," by Prof. Osann.

(2) "The Hardness of Cast Iron at Elevated Temperatures," by Dr. Franz Roll.

(3) "Motion Studies and their Application to Foundry Practice," by Oberingineur G. Stern.

The meeting on the following day, Sunday, May 25, will include the business part and the report concerning the activity of the Association and also the following Papers:—

(1) "Recent American Research on the Physical Properties of Cast Iron," by Dr. P. Bardenheuer.

(2) "Thoughts on the Problem of a New Industrial Policy," by Dr. J. Winschuh.

At the close of the official part, as usual, a banquet will take place in the Kaisersaal of the Zoological Gardens.

In connection with the general meeting there will take place on May 26 a meeting of the National Technical Committees for Foundry Practice. Furthermore, in the External Institute of the Technical High School in Berlin, in conjunction with the Association of German Foundry Technical Association Experts, the German Institute of Metals and the combined Associations of German Metal Foundries are organising to follow on, after the general meeting of the Association of German Foundries, May 26 to May 28, a series of technical non-ferrous Foundry High School Papers:—

(1) "Remelted Aluminium: Its Properties and Treatment," by Dr. Sterner-Reiner.

(2) "Nickel in Cast Metals," by Oberingenieur Tillman.

(3) "Special Bronzes," by Dr. W. Claus.

(4) "Density and Gas Content of Cast Aluminium Alloys and the Influence of these Factors brought about through Melting Conditions," by Dr. H. Nipper.

(5) "Fettling Non-ferrous Castings (I)," by Dr. M. Kurrein.

(6) "Psycho-Technology in Foundry Practice," by Dr. H. Rupp.

(7) "Die Castings," by Ing. P. Weiss.

(8) "Standardisation of Non-ferrous Metals and Alloys," by Dr. W. Claus.

(9) "Fettling Non-ferrous Castings (II)," by Dr. M. Kurrein.

(10) "Foundry Costing," by Prof. Dr. W. A. Auler.

(11) "The History of Dr. Künzel's Phosphor-Bronze," by Dr. W. Claus.

Tickets for members of the above-named Associations are obtainable at the preferential price of RM. 15 from the business offices of these Associations.

Reports and Dividends.

Ransomes & Rapier, Limited.—Profit, £18,207; brought in, £11,739; dividend of 6 per cent. on the ordinary shares, tax free; to reserve, £10,000; carried forward, £11,040.

Pressed Steel Company of Great Britain, Limited.—Net profit for 15 months to December 31 last, £41,380; refund of Customs duties, £4,036; debit balance brought in, £9,739; carried forward, £35,677.

The Iron and Steel Institute.

ANNUAL MEETING IN LONDON.

The Annual Meeting of the Iron and Steel Institute was opened Thursday, May 1, at the Institution of Civil Engineers, Great George Street, Westminster, Prof. Henry Louis (President) in the chair.

Report of Council.

The Council of the Institute in their report state that during the past year 110 new members and 11 associates were elected; 6 associates were transferred to membership, and 6 members were reinstated. Forty-seven members resigned their membership during the year, and the names of twenty-six members were removed from the register owing to the non-payment of their subscriptions. The total membership of the Institute on the register on December 31, 1929, was accordingly as follows: Patron, 1; honorary members, 5; life members, 76; ordinary members, 1,922; associates, 18; total, 2,022. This indicates an increase of fourteen in the total membership. The deaths of 32 members of the Institute had occurred during the year. The Council deeply regret to have to record the deaths of Mr. M. Mannaberg, the senior Vice-President of the Institute; of Mr. Illtyd Williams, who served the Institute as Honorary Treasurer throughout the difficult period of the war and for the eight years following; Mr. F. W. Gilbertson, who served on the Council from 1920 to 1924; Mr. H. G. Graves, who served the Institute for fifteen years in the capacity of abstractor for the Journal; and Mr. Louis M. de Aznar, who was associated with the well-known firm, Messrs. Sota & Aznar, at Bilbao. The Council also desire to pay a tribute to the memory of Prof. J. O. Arnold, F.R.S. (Honorary Vice-President), whose death took place on March 27, 1930.

Finance.—The income for the year under review, apart from that of the Carnegie Scholarship Fund and of the Special Purposes Fund, was £7,974, and the expenditure was £8,123, as against £7,940 and £7,918 respectively in 1928.

Andrew Carnegie Research Scholarships.—On the recommendation of the Carnegie Research Committee, grants were made by the Council during the year to the following candidates:

R. Higgins (Glasgow), £100, to assist him in research work under Prof. J. H. Andrew at the Royal Technical College, Glasgow, on behalf of the Heterogeneity Committee, the subject being the determination of the liquidus and solidus of carbon and alloy steels, and a study of reactions of sulphides in liquid and solid steels.

B. S. Smith (Sheffield), £100, to assist the continuation of his research work under Prof. C. H. Desch, F.R.S., at Sheffield University, on behalf of the Heterogeneity Committee, the subject being the viscosity of molten steel.

R. H. Aborn (Cambridge, Mass., U.S.A.), £100, in aid of a research on the occurrence of oxygen in iron and steel and its influence, particularly on red-shortness.

J. E. Dangerfield (Birmingham), £100, in aid of a research on nickel and silicon in whiteheart malleable cast iron, with special reference to thin-walled malleable.

S. G. Ericson (Stockholm), £100, to assist in determining directly the volume change occurring at the solidification of iron.

A. L. Norbury (Birmingham), £100, in aid of a research on the effects of special elements on the physical and mechanical properties of cast iron.

H. O'Neill (Manchester), £50, to assist in an investigation of the hardness of metals as determined by a method of "unrecovered" indentation measurement.

Changes on the Council.—Mr. W. Simons has been elected Vice-President to fill the vacancy caused by Prof. Louis' accession to the Presidency, and Mr. H. C. Bond was elected a Member of Council to take the seat vacated by Mr. Simons. In accordance with Byelaw 10, the names of the following Vice-Presidents and Members of Council were announced at the Autumn Meeting as being due to retire at the Annual Meeting, 1930:—Vice-Presidents: Mr. H. Brearley; Mr. W. Simons; Mr. G. Hatton, C.B.E. Members of Council: Mr. A. Dreux; Lt.-Col. Maurice Bell, C.M.G.; Mr. J. Henderson; Professor T. Turner; Mr. W. G. Gray. A vacancy in the above list of Vice-Presidents consequent on the retirement of Mr. Brearley has since been filled by the election of Prof. C. H. Desch, F.R.S. No other members having been nominated up to one month previous to the Annual Meeting, the above-mentioned retiring members, subject to the change specified, in accordance with the announcement made at the Autumn Meeting, were presented for re-election.

PROF. HENRY LOUIS, M.A., D.Sc., A.R.S.M., M.Inst.C.E., F.I.C., F.G.S.
(*President of the Iron and Steel Institute*).

Committee on Heterogeneity of Steel Ingots.—The First Report of this Committee in 1926, and the Second in 1928, contained records of the collective work of the members of the Committee. The Third Report, presented in 1929, dealt with researches into questions connected with the casting and freezing of ingots, including the density of molten steel, the liquidus and solidus ranges of steels, the solubility of iron and manganese sulphides in steel, and the effect of latent heat on the solidification of steel ingots. A programme for the study of experimental ingots made at Sheffield University is now in hand. As the cost of carrying out these investigations has increased to an amount beyond what the Institute can meet out of its own fund, the National Federation of Iron and Steel Manufacturers has generously agreed to assist by making a grant of £2,000, spread over three years, in aid of the work, and the Committee is now a joint Committee of the Iron and Steel Institute and the National Federation.

Corrosion Committee. — This Committee has been mainly occupied with the consideration of the conditions under which corrosion tests should be carried out to best advantage and of the material to be employed for such tests. Plans are being prepared for conducting field tests on the corrosion of copper steels under different atmospheric conditions, rural, marine, urban and industrial. Dr. J. C. Hudson, formerly on the staff of the British Non-Ferrous Metals Research Association, has been engaged for three years to act as Investigator and Reporter to the Committee, which is now a joint Committee of the Iron and Steel Institute and the National Federation of Iron and Steel Manufacturers, and for the funds wherewith to carry out the work the Institute is again indebted to the National Federation, which is contributing to the cost of the research work £2,000, spread over three years. The British Steelwork Association has likewise granted £150 towards the same object.

The annual report and statement of accounts for 1929 having been adopted, the following amendment to By-law 10 was unanimously confirmed, namely, to delete in line 1 of the existing By-law the words, "The President shall be elected for one year," and to insert in place thereof the words, "The President shall be elected for two years and shall not be eligible for re-election until after an interval."

Presentation of Bessemer Gold Medals to M. Eugène Schneider, Sc.D., and Dr. Walter Rosenhain, F.R.S.

The PRESIDENT, in presenting the medals, said that one of the pleasantest tasks that fell to the lot of the President of the Institute was the annual presentation of the Bessemer Medal. The Council of the Institute had before it the names of two gentlemen, each so admirably qualified to receive this medal that it found itself in the position of being unable to prefer either of them to the other, and, therefore, decided to confer the honour of the Bessemer Medal upon each of them. This was a course that had been adopted on a few previous occasions.

The medal was instituted in 1874, and out of the fifty-seven years on which the medal had been awarded, two had been awarded simultaneously on five occasions. He felt amply assured that the meeting would cordially endorse the action of the Council in deciding this year to award two Bessemer Medals, one to M. Eugène Schneider and the other to Dr. Walter Rosenhain. Both these gentlemen were so well known to members of the Institute that he need say very little about them. It would be remembered that M. Schneider was President of the Institute in the years 1918 to 1920. He was the head of the famous firm of Le Creusot, founded in about 1800 by his grandfather. His father, M. Henri Schneider, who succeeded in due course to the headship of the firm, extended the works greatly and made its reputation as a manufac-

turer of artillery and armaments generally. It was interesting to recall that the Bessemer Medal was awarded to M. Henri Schneider in 1889, this being also one of the exceptional occasions on which two medals were awarded in the same year. M. Eugène Schneider became the head of his great firm in 1898 on the death of his father and had actively continued their development. In his capacity as head of these various important metallurgical establishments, he had contributed very largely indeed to the advancement of the metallurgy of iron and steel and was, therefore, eminently fitted to become a recipient of the Bessemer Medal, whilst the Iron and Steel Institute felt also a full measure of pride in being able to add his name to the distinguished roll of previous recipients.

M. Eugène Schneider
(*Bessemer Gold Medallist*).

Eugène Schneider was born at Le Creusot, France, in 1868. His grandfather, Joseph Eugène Schneider (1805-75), was Minister and President of the Corps Legislatif under Napoleon III, member of the Privy Council of the Emperor, and ironmaster at Bazeilles. At the beginning of the last century he purchased the ancient royal foundry of Le Creusot, which was built in 1782, under the patronage of Louis XVI, and he thus laid the foundations of the present firm. Considerable development took place under the direction of his son, Henri Schneider, who was born in 1840 and died in 1898. Henri Schneider was a member of the Chamber of Deputies from 1889 to 1898. The present head of the Creusot works soon became initiated to industrial life. In 1887, when he was only 19 years of age, and after having completed his education and fulfilled his military obligations, he began to co-operate with his father, and very shortly afterwards he became his associate. When Henri Schneider died in 1898, Eugène Schneider remained alone as head of the firm. He also succeeded his father as member of the Chamber of Deputies until 1910. Since then he has devoted all his time to the development of the works and to the creation of new enterprises. After the war, M. Schneider was faced with the problem of adapting the works to new conditions, and, thanks to the renovation of the equipment and to a new adjustment of methods in relation to modern economic necessities, the firm has maintained its rank as a leader in European industry. At the same time, M. Schneider acquired a considerable interest in iron and steel concerns in Luxemburg and in Central Europe, and also in several iron and steel works and engineering concerns in France. He thus concentrated under the influence and control of his firm a powerful amalgamation of interests, the activity of which covers all the specialities of modern metallurgical and engineering industries. Eugène Schneider was President of the British Iron and Steel Institute from 1918 to 1920. At the end of 1919 he was appointed, by the French Government, chairman of the Economic Mission which was sent to the United States at that time. He was awarded the gold medal of the Mining and Metallurgical Society of America, and made an honorary member of the American Iron and Steel Institute. He holds the degree of Doctor of Science of the University of Pittsburgh, and was given the Freedom of that city. He is also a Doctor of Science *honoris causa* of he University of Western Reserve in the city of Cleveland, and honorary Doctor of Engineering of the Stevens Institute of Technology. He holds the John Fritz medal. He also holds the Grand Croix of many foreign orders. He is an honorary Freeman of the Blacksmiths' Company, one of the most ancient and important Guilds of the City of London.

Prof. Louis then presented the medal to M. Schneider.

M. Eugène Schneider, replying, said he was deeply sensible of the honour which the Institute had conferred upon him. The President had reminded him that forty years ago the Institute had bestowed the same honour upon his father. He was deeply touched that they should have considered himself worthy of the same distinction. He was the happier in receiving the medal, since his name was associated in the honour with that of one of the greatest British scientists, his friend Dr. Rosenhain. The Institute had thus honoured at the same time science and industry, whose close alliance in iron and steel manufacture had proved so fruitful and so indispensable to the enormous developments of recent years. To that alliance he himself attached the greatest importance in the management of the works which came under his control. He was glad to say that the hand-in-hand work of industry and science was greatly benefited by the activities of the Institute, where under the same roof industrialists and scientists worked in close co-operation for the betterment of methods of working in the industry as a whole. He desired to thank His Excellency the French Ambassador for having consented to come to the meeting in order witness the bestowing of the Gold Medal upon one of his fellow-countrymen. It was with the very deepest feeling of gratitude that he received the Gold Medal, which he would treasure as a valued honour, and he thanked the Institute most sincerely for having added his name to those of previous distinguished recipients.

M. de Fleuriau (the French Ambassador), who was among those present, said it was a very great honour and pleasure to be able to attend this celebration, which showed that the work of the Institute was not only national but international. The bestowing of the medal on M. Schneider was one of those things which would tend to increase and better the relations between France and Great Britain.

The President, in presenting the other Bessemer Medal to Dr. Walter Rosenhain, said that he was too well known to those meetings to need any introduction to members of the Iron and Steel Institute. He came to this country from his birthplace in Australia as an 1851 Research Scholar in the year 1897, and promptly devoted himself to metallographic work, with such marked success that in 1899 he published, with Sir Alfred Ewing, the famous Joint Paper announcing their discovery of the "slip bands" in metals that underwent mechanical deformation. Since that Paper Dr. Rosenhain had done an enormous amount of research work among metals, especially on behalf of the Alloys of Iron Research Committee, and had contributed numerous Papers mainly dealing with the microstructure and the physics of metal to scientific and technical societies, whilst his book, "Introduction to the Study of Physical Metallurgy," was widely and most favourably known. In 1906 he was appointed to the Directorship of the then newly-established Department of Metallurgy in the National Physical Laboratory; he commenced his work there with a staff of four, and has so increased his sphere of operations that to-day he has no less than seventy workers under his direction.

In handing Dr. Rosenhain the medal, the President expressed the wish that he might continue his labours in metallurgical science for very many years to come and that he would continue to give the Institute the benefit of his researches.

Dr. Rosenhain, in reply, said it was difficult to express adequately the feelings of profound pleasure and delight with which he received the medal. The recognition in such a manner of many years of work was bound to affect one deeply, but in expressing his thanks to the Institute for the presentation, he desired to say that it must be regarded that the work which the Council of the Institute had recognised in that manner was more the work of the leadership of a group of able and enthusiastic workers than it was of individual work of his own. It would have been quite impossible to have carried out the work but for the splendid group of men who, although they had changed from time to time, had followed the work and developments of the Metallurgy Department of the National Physical Laboratory during the last 24 years. Many of those men were still with him. Others had gone to occupy posts of high importance elsewhere in the country. But he was sure that, whether they were with him still, or whether they had gone elsewhere, they were continuing in that spirit of inquiry to carry forward the effort to advance the present knowledge of metallurgy.

The juxtaposition of his name with that of the honoured name of M. Schneider was a thing which he personally viewed as a happy augury.

Dr. Walter Rosenhain
(*Bessemer Gold Medallist*).

Dr. Walter Rosenhain was educated in Melbourne, Australia, graduating from the University of Melbourne in physics and engineering in 1897. He then came to England as holder of one of the research scholarships of the Royal Commission for the Exhibition of 1851, which enabled him to spend three years on research at Cambridge, where he worked mainly in collaboration with Professor (now Sir Alfred) Ewing. It was at the suggestion of the latter that he took up the microscopic examination of metals, having first spent some time with the late Sir William Roberts-Austen at the Royal Mint, and with the late Prof. J. O. Arnold at Sheffield in acquiring the technique of the new work. This work shortly led to the discovery of "slip bands," and a little later to that of the phenomena of spontaneous annealing or recrysallisation in lead and other soft metals at room temperatures. In 1901 Dr. Rosenhain took up the post of scientific adviser to Chance Bros. of Birmingham, glass manufacturers and lighthouse engineers; during the five years spent in Birmingham he was chiefly concerned with the production of optical glass and of lighthouse apparatus. In 1906 Dr. Rosenhain was appointed first Superintendent of the Department of Metallurgy and Metallurgical Chemistry at the National Physical Laboratory, a post which he still holds after 24 years of continuous service. The Department, newly formed in 1906, was very small with a total staff of only four, and it has grown immensely in size and importance, until to-day it ranks as one of the foremost metallurgical research laboratories in the world. Dr. Rosenhain himself has published a very large number of papers and addresses, but under his leadership a still larger number of contributions to scientific metallurgy have been made by the staff of his Department at the N.P.L. This work has covered the whole field of physical metallurgy, both ferrous and non-ferrous. Dr. Rosenhain was elected F.R.S. in 1913. He was President of the Institute of Metals from 1928 to 1930, and has been elected a Fellow of that Institute. He is also a Fellow of the Institute of Physics. Since 1927 he has been British Delegate on the Permanent Committee of the new International Association for Testing Materials, and has been elected President of Group A (Metals) of that Association. He has been invited at different times to give lectures and addresses in many foreign countries (America, 1923; Germany—Düsseldorf, 1929; Switzerland—Zurich, 1929), and is shortly going to Sweden to deliver an Opening Address at the meeting of the Jernkontoret in Stockholm.

Incorrect Weighting of Moulds.

By "Vallishe."

On looking through the foundry records of a medium-size jobbing shop, the percentage of waster castings over a full year's working was shown to be exactly 9 per cent. (taken on a weight basis). These records included a brief diagnosis of the various causes of the wasters. One outstanding cause was stated to be as follows:—"Uneven thickness of metal, brought about through core lifting when casting." Other remarks were:—"Body of casting twisted"—"core crushed."

Although the causes outlined above only represented approximately 1 per cent. of the waster castings, if that percentage could be almost completely avoided one would feel amply repaid for devoting much attention to the matter. The foundry in question has an average annual output of 2,000 tons of iron castings; thus the comparatively small 1 per cent. would mean twenty tons of castings saved from the scrap heap, or, roughly, a saving of, say, £150 per annum (making a weight allowance on waster castings).

The chief cause of this class of waster casting is without doubt either insufficient or excess weighting and clamping of the mould. Many foundrymen, although quite capable in other matters, seem to be almost at an entire loss when questioned as to the actual weight required to hold down a particular core. Consequently, "rule of thumb" is the only guide they have, and in many cases they are hopelessly mistaken.

When one studies the question of weighting and clamping of moulds, it is really surprising how many factors have to be taken into account. They include:—(*a*) Type of casting and sizes of same, (*b*) sizes and weight of box, (*c*) area and estimated weight of sand when rammed, (*d*) the head pressure (this is determined by the height of the runner box from the bottom of the core or mould), (*e*) number of runners and (*f*) buoyancy.

Determining the Lifting Pressure on a Core.

To determine the lifting pressure on a core there are three governing factors:—(1) The head, (2) the diameter or size of the core and (3) the length of the core. As an example, one can take a 4-in. bore flanged pipe, 9 ft. long, with a 10-in. head (that is 10 in. from feeding point to bottom of core). The static pressure on this core would then be:—Diameter of pipe in feet ($\frac{4}{12}$) × head in feet ($\frac{10}{12}$) × length in feet (9) × $\frac{448}{112}$. This gives $\frac{4}{12} \times \frac{10}{12} \times 9 \times \frac{448}{112}$ = approximately 10 cwts. Assuming the box to measure 10 ft. × 1 ft. wide, and the cubical contents of the sand when rammed to be 3½ cub. ft., the weight of the box can be estimated at 1½ cwts. and the sand, assuming the weight of rammed sand at 100 lbs. per cub. ft., or 350 lbs. This gives a total weight on the core, or rather a weight pressing down against the subsequent lifting pressure, of approximately 4½ cwts. Thus the extra or loose weight required to counteract the lifting pressure would be 5½ cwts. This estimated weight should be increased at least 10 per cent. to allow for any unforeseen causes, such as sudden pressure due to faulty feeding. Again, the lifting pressure is increased according to the number of runners. In the calculations just given the weight of the core and the pressure of the atmosphere have been ignored. Only with particularly large and heavy castings need these factors be taken into account. In jobbing foundries where pipes and similar types of castings are largely produced, Table I giving the pressures on cores (round or square) is useful, and if displayed in a prominent position in the foundry will prove a valuable guide to the moulder. The pressures given are for cores 9 ft. long, but it is a simple matter to calculate the pressure for any length of core by either division or subtraction, as the case may be. The pressures are given in cwts. The weights of the box and sand must, of course, be taken into account and subtracted from these figures. Clamping and staking must also be reckoned, all these items, of course, reducing the amount of additional weight required.

Table I.

Diameter of core (in in.)	Height from runner box to bottom of core (in inches).																		
	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66
2 ..	6	7½	9	10½	12	13½	15	16½	18	—	—	—	—	—	—	—	—	—	—
3 ..	9	11	14	16	18	20	23	25	27	—	—	—	—	—	—	—	—	—	—
4 ..	12	15	18	21	24	27	30	33	36	39	—	—	—	—	—	—	—	—	—
5 ..	15	19	23	27	31	35	39	43	47	51	55	—	—	—	—	—	—	—	—
6 ..	18	23	27	32	36	41	45	50	54	59	63	69	—	—	—	—	—	—	—
7 ..	21	26	32	37	42	47	53	58	63	68	74	79	—	—	—	—	—	—	—
8 ..	24	30	36	42	48	54	60	66	72	78	84	90	96	—	—	—	—	—	—
9 ..	27	34	41	47	54	61	68	74	81	88	95	101	108	—	—	—	—	—	—
10 ..	30	38	45	53	60	68	75	84	89	98	106	113	120	128	—	—	—	—	—
12 ..	36	45	54	63	72	81	90	99	108	117	126	135	144	153	—	—	—	—	—
15 ..	45	56	68	79	90	101	113	124	135	146	158	169	180	191	203	—	—	—	—
18 ..	54	68	81	95	108	122	135	149	162	176	189	203	216	230	243	257	—	—	—
21 ..	63	79	95	110	126	142	158	173	189	205	221	236	252	268	284	300	315	—	—
24 ..	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324	342	360	378	—
27 ..	81	110	122	142	162	183	203	223	243	263	284	304	324	344	364	385	405	425	446
30 ..	90	113	135	158	180	203	225	248	270	293	315	338	360	383	405	428	450	473	495

Pressures given are in hundredweights.

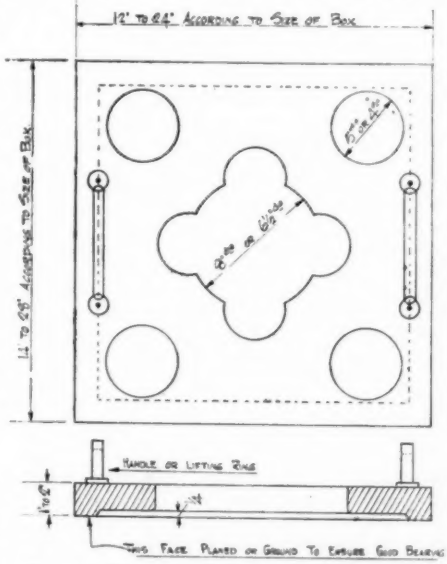
12" TO 24" ACCORDING TO SIZE OF BOX
14 TO 24" ACCORDING TO SIZE OF BOX
HANDLE OR LIFTING RING
THIS FACE PLANED OR GROUND TO ENSURE GOOD BEARING

Fig. 1.—The Plate used for Weighting Small Moulds.

come is low. In the case of snap flasks or boxes of similar design and weight it is a good idea to have special weights made as is illustrated in Fig. 1. The thickness of the plate should be from 1 in. to 1¾ in. thick, according to the class of mould for which it is required. The best plan is to have several plates of varying thicknesses, each having its respective weight stamped or painted on. The surface of the plates should be quite smooth, and if on the rough side should be machined. The holes in the centre and corners are provided for pouring and should be not less than 4 in. in dia. Handles should be fastened to each plate to facilitate handling.

Such weights save much time for the moulder, besides ensuring greater accuracy in weighting. Nothing is more annoying for the foundryman than having to hunt round the shop for suitable weights, and then in the end to find that he has only a very rough idea as to exactly what weight must be put on the box.

Buoyancy.

Some foundrymen maintain that a dull and sluggish iron exerts less pressure on the core or mould. This can hardly be true except in exceptional cases. In fact, it is not altogether impossible for a sluggish iron to exert an even greater head pressure than a free-flowing iron, this being caused through the metal at the risers setting rapidly. However, neither case can be worthy of much concern.

Weighting Small Moulds.

There are many ways of weighting small moulds in jobbing foundries. Some use pig-iron, small weights or even bad castings, if of suitable conformity. Such weights, however, are only generally very light, as the pressure to overcome is low. In the case of snap flasks or boxes of similar design and weight it is a good idea to have special weights made as is illustrated in Fig. 1. The thickness of the plate should be from 1 in. to 1¾ in. thick, according to the class of mould for which it is required. The best plan is to have several plates of varying thicknesses, each having its respective weight stamped or painted on. The surface of the plates should be quite smooth, and if on the rough side should be machined. The holes in the centre and corners are provided for pouring and should be not less than 4 in. in dia. Handles should be fastened to each plate to facilitate handling.

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Clamping.

Numerous accidents have occurred through either faulty clamping of the box or the clamps being too weak. The writer has seen moulders driving wedges at the top side of clamps. This practice is decidedly bad, for not only is he lifting the whole weight of the clamp, but he is making it most difficult to get the clamp on a solid base. There is also always the chance of disturbing the mould, especially in intricate and delicate moulds. Bottom wedging is much better, besides being infinitely easier and quicker to accomplish.

In calculating the size of clamps, a strain of 15,000 lbs. per sq. in. for best wrought iron and 5,200 lbs. per sq. in. for good cast iron should be allowed. The number of clamps and the distance apart should also be determined. It should be mentioned, however, that for heavy work, cast-iron clamps should be discarded, in so much as they are apt to break under the strain.

Foundries specialising in repetition work are able to arrange facilities for bolting-down the moulding boxes, especially when certain boxes

have a more or less permanent position in one particular part of the shop. In such instances the amount of loose weight required to hold down the cope is greatly reduced and in some cases entirely unnecessary. Jobbing foundries, however, would find it impossible to make such arrangements, and in their case the question of "loose" weighting becomes a much larger problem.

Uneven Distribution of the Weight.

Providing a number of tables, showing the lifting pressure on various classes and sizes of castings produced generally, are exhibited in a prominent position in the moulding shop, the possibility of losing an otherwise good casting through under- or over-weighting will be greatly reduced. Other factors, however, must not be overlooked. Many moulds have been spoilt through uneven distribution of the weight. Care must always be taken in placing the weights on the top box so that even distribution is assured. A few light-section steel joists are ideal for carrying the weights, especially when the box is of large dimension. Every moulding shop should have several suitable lengths of 4-in. × 3-in., 6-in. × 3-in. and 8-in. × 4-in. R.S. joists by them. Besides being ideal for distributing the total weight, they obviate any possibility of disturbing the sand in the top part.

Extra weight—at least 5 to 10 per cent.—should be allowed for counteracting momentum lift (caused by the sudden stopping of the inflowing iron when the mould is full). Other items to be considered are the number and the size of runners. A casting with two or three gates will require more weight to hold it down than one with only a single gate.

Attention should also be paid to the box hinges and pins before weighting is commenced. The writer has seen several cases in which the top part has not been sitting true on the bottom box, and consequently when the weight was applied to the former a drop took place.

Perhaps a few words should be said on the question of crushing a mould through overweighting. Although this sometimes happens the chance is a small one compared with the one of under-weighting. A moulder who causes a crush directly through excessive weighting either has no idea whatever on the subject or is making doubly sure of himself—the result of "rule-of-thumb" methods.

Conclusions.

If the moulder in general would make himself fully acquainted with fundamental principles embodying the lifting pressure on a core or mould, coupled with the other independent factors briefly outlined in this article, he would acquire a knowledge which would stand him in good stead. Nothing is more aggravating and unsatisfactory than being uncertain in one's own job, for, after all, what is the use of weighting a mould with, say, 2 tons when 30 cwts. would have been nearer the mark had one known?

Ferro-Vanadium from South Africa.—According to the South African papers to hand by a recent mail the Rhodesia Broken Hill Company has at last decided to proceed with the erection and operation of the ferro-vanadium plant which was embodied in the original scheme of equipment and production. Certain anticipated difficulties in the marketing of ferro-vanadium were chiefly responsible for the delay with this section of the plant. These difficulties have now been overcome. It may be remembered that the experimental work done by the pilot plant resulted in the successful development of methods, since covered by patents, for precipitating the vanadium in the ore, and producing a high-grade vanadium product, suitable for treatment in the electric furnace for the production of ferro-vanadium. It is expected that the ferro-vanadium to be produced from the new plant will contain from 30 to 40 per cent. vanadium metal, and much less than the usually specified limits of such impurities as sulphur and phosphorus. The annual output is estimated to reach 630 tons of ferro-vanadium (34 per cent. V.).

Foundry Sands.

At a recent meeting of the London Junior Section of the Institute of British Foundrymen held in the offices of The Foundry Trade Journal, Mr. J. L. Francis, metallurgist to Messrs. Reavell & Company, Limited, read a Paper entitled "Some Practical Notes on Foundry Sands." In the absence of the chairman, Mr. F. C. Cummings presided.

The lecturer commenced with a careful survey of the essential physical properties of foundry sands, pointing out that for whatever purpose they were required the sands should possess bond or cohesiveness, permeability, refractoriness or heat-resisting properties, durability, etc.

Bond.

With regard to clay-content, the lecturer emphasised that in order that the clay may exert its maximum bonding influence it should be in the form of a thin, even coat around every sand grain. Natural moulding sand often had the clay present as nodules distributed indiscriminately throughout its mass. In this condition, although excessive clay may be present, little or no bond will be evident and the sand will not readily hold together.

Permeability.

Permeability and porosity are properties of foundry sand which are not synonymous. Porosity may be taken as a measure of the total pore space, whilst permeability depends on the number of interconnected pore spaces. The shape of the sand particles determines porosity, but uniformity of grain dimensions largely decides the value of the permeability. From the point of view of porosity and permeability, the theoretically perfect sand would be one made up of spherical grains of uniform size.

Refractoriness.

Silica or quartz grains form the major refractory element in foundry sands. Silica, when present alone, is very refractory, but at high temperatures in the presence of fluxing elements, such as iron, lime, magnesia, potassium and sodium, it fuses and forms silicates. With the presence of the latter two metals, silicates are formed as low as 700 deg. C., and such a sand would readily fuse and burn into a molten metal. Texture, too plays an important part in determining the refractoriness.

Deterioration of Foundry Sands.

Foundry sand requires repeated additions of new sand and reconditioning, because, after having been acted on by molten metal, it loses its cohesion and permeability. Some of the bonding constituents become burnt and destroyed and the quartz grains break down; thus the percentage of silt and fine particles is increased. Any coal dust in the facing also becomes burnt, leaving a fine ash, and the general trend is towards a clogging up of the pore spaces and a permanent destruction of bond.

Another factor contributing to the deterioration of the floor sand is an accumulation of iron particles, so small as to pass through the riddle. These tend towards burning-on difficulties and also by rusting, and being present in the mould face cause agitation during pouring.

Preparation.

The preparation varies in its details according to the purpose for which the sand is intended. Regarding the problem of uniform bond distribution, two processes are used. The first consists in thoroughly mixing the old and new sand in a dry state and then wetting the mixture; the second causes the mulling to be done in the moist condition. For natural sands the latter method is preferable.

The blending of sands is another point needing very cautious handling. Two sands both of which may be quite excellent for foundry purposes may, when mixed together, produce a sand of a very indifferent nature. Where a sand of open texture is mixed with one of much finer grain size both may be spoilt. The addition of coal dust should be reduced to the smallest amounts that will give the desired results. Silt formed from coal-dust ash is commonly a lime iron silicate of fusible character. Such silt not only plugs up the pore spaces but seriously reduces the bond strength at the mould surface at casting temperatures. It also causes bad skins on castings by reason of its fusible nature, not only making an unsightly finish but, at the same time, making much extra fettling necessary. Coal dust should never be coarser than the grain of the sand with which it is mixed.

Core Sand.

In many cases the same mixtures of sand serve for both cores and moulds, but usually core sand should contain more opening material than facings for moulds. Cores are often completely surrounded by metal, and hence the sand mixtures should be more porous to allow the expanded air and gases to escape.

Tempering.

Three main factors govern the strength of a given sand, viz.: (1) Milling, (2) ramming density, (3) moisture content. Moisture is not the least important, as unequal distribution of moisture is a great cause of weakness. Wet spots do not permit of easy passage of the gases evolved during casting, and a wet area is a fruitful sourse of scabs and blowholes. As a general rule green-sand facings contain 5 per cent. moisture.

Oil Sand.

The sand for mixing with binding oils must be devoid of any natural bond. Dust and broken shell should also be absent. Dune, beach and river sands are employed. They are essentially silica sands of a high degree of purity. The best binding oils are composed of linseed oil or at any rate contain this oil as a base; about 3 to 4 per cent. of oil to sand being considered proportionate. For accurate working the sand to be treated should be dry, the oil being added as an emulsion with the water, and the whole thoroughly mixed. Regularity of mixing is very essential, and this cannot be secured without previous drying of the sand. Experience shows that an emulsion of the oil with water ensures a very much better mixture with the sand and a better and stronger core results. A maximum of 5 per cent. moisture should not be exceeded, however.

Nowadays requirements for constructional materials are specified to fall within much narrower limits than heretofore. They also call for better quality with higher physical properties. At the same time, if the foundryman is to meet successfully all the demands made upon him he must in his turn insist that the materials with which he works conform to special requirements. Of these materials sand is an exceedingly important item.

The lecturer showed a series of interesting lantern-slides, certain of the photographs having been loaned him by courtesy of the British Cast Iron Research Association.

New Companies.

F. C. Metal Processes, Limited, 85, London Wall, London, E.C. Capital £20,000.

Holland Foundry, Limited, 150, Southampton Row, London, W.C.—Capital £2,000. Directors: J. A. Ruchton and F. T. Smith.

Allied Engineering Industries, Limited.—Capital £3,000. Solicitors: Amery, Parkes & Company, 1, Arundel Street, London, W.C.

The Cost of Defective Castings.

An interesting Paper on "Features in Casting Affecting the Process of Manufacture" was given by Mr. Wilfred Dresser, a member of the Middlesbrough Branch of the Institute of British Foundrymen, following the annual meeting of the branch, over which Mr. N. D. Ridsdale, the retiring President, presided.

MR. DRESSER said that while a great number of really beautiful castings, which one saw everyday, filled one with admiration for the skill of the moulder, there were sometimes instances when he fell from grace and produced castings which gave trouble. Many of the defects were quite obvious to the moulder the moment the casting was out of the mould, but it might not be so clear just how and why they caused trouble in the succeeding stages of manufacture. Dealing with blowholes and cold shuts, etc., he said a gear-wheel blank might have a cavity right inside the rim.

A £500 Loss.

The boss will be bored, faced, keywayed and possibly turned, and the rim machined to form the blank. Frequently the wheel will be sent some distance by rail for the cutting of the teeth, and it may not be till perhaps half of the hobbing is done that the cavity shows itself and probably leads to the scrapping of the wheel—this after, perhaps, 90 per cent. of its total cost has been expended. Take the case of the Diesel cylinder liner. It will be rough bored, turned with many grooves, milled and drilled in a dozen different ways, after which a cast-steel jacket will be shrunk on and lubricators fitted. Then it will be finally bored before being put on the internal grinding machine for the finishing of the bore. By that time its cost will have mounted to something like £500 and if, in the course of grinding a blowhole is uncovered which necessitates the scrapping of the liner and jacket, the loss will be heavy, indeed. If, then, the moulder must put a blowhole in a casting, one is tempted to ask him to keep it where the first machining will remove it or at least expose it. Before leaving this subject it might be well to stress the importance of foundrymen not attempting to cement such defects. If iron cement is permissible at all, it should be only applied with the full permission of the customer's inspector or other fully responsible official, and probably is best kept out of the foundry and fettling shop altogether. Few things can detract more from the name of the firm than the discovery of a surreptitious attempt to patch up and conceal a flaw. Dealing with porosity, the lecturer said it is after all or most of the machining has been done that the condition shows itself, by causing sweating on water test, and though the strength may be ample, the attempt to get the casting watertight may take days and so considerably increase the manufacturing programme of the apparatus.

Surface Defects.

Coming to surface unevenness, he said the expenditure of time in machining is a necessary evil and it is in the foundry that early endeavours should be made to reduce it. Practically every machined surface should clean up—namely, no patch of unmachined metal should show after the finishing cut has been taken. This means that the total depth of cut which must be taken is governed by the deepest hollow in the surface; local humps can be removed in the fettling shop by means of a pneumatic chisel and therefore are not so bad. But a small hollow, only a square inch or so in area and a quarter of an inch deeper than any other part of the surface, may mean the removal of that depth of extra metal from an area several times as great, thereby increasing the cutting time by an hour or so and entailing a cash loss of anything up to one pound. Irregularities in surfaces not to be machined are rarely objectionable except in special cases where appearances are of paramount importance. Coming to surface texture, he said the machinability of the surface material is of the greatest importance in reducing the cost of machining operations. The actual time during which a machine will be running for the purpose of cutting will be anything from a third to two-thirds of the total time of the job. A good high-speed tool ought to be able to take a cut of $\frac{1}{4}$ in. with a feed of $\frac{1}{16}$ in. at 75 ft. per min. on grey iron having a good skin. A casting with a hard skin, however, will not sustain a speed of 45 ft. per min. with the same tool. Small steel castings are sometimes impaired by a hard skin, and cases are known where the finest quality tool steel has failed and stellite simply crumpled the moment the tool came into the cut. Speaking as to scabs, adhering sand, etc., he said these can be a great source of danger when they occur on the inside of water-cooled pistons of internal-combustion engines. Owing to the complications of the corings most conscientious efforts of the fettlers may fail to detect and remove a scab, with the result that it might cause local overheating in service or by becoming detached be carried to some point in the cooling water system where it would block the passage and so cause a breakdown of the engine due to general overheating.

Misplaced Cores.

As to misplaced or ill-matched cores, Mr. Dresser said it is fairly obvious that misplaced cores in the casting of pipes, bottles, etc., may make the metal dangerously thin in places, but it would seem that the chief danger lies in such defects not being discovered till a fracture actually occurs in service. Weeping on test will sometimes give a hint and the drilling of holes for the purpose may lead to immediate discovery, but unfortunately much machining may have been done in the meantime. Quite a common source of extra work and poor finish is the imperfect matching or meeting of cores. Sluice doors frequently have a short passage communicating with the interior of the main vessel, and one often finds extensive flashes partly blocking the hole just where the cores should have met but failed. Where parts are cast in engine cylinders such flashes involve much extra work in the fitting shop. For the sake of the efficiency of the engine the various ports must be accurately finished. Hence, when a casting is rough, uneven and bristling with fins where the cores meet, much very awkward handwork is necessary, and, even when a portable grinding wheel is used, men will be working on the job for several days, with consequent soaring of the labour costs. Twisted or distorted castings, he said, usually give the marker-off a difficult job, and in spite of the greatest care it may be found that machine surfaces will not quite clean up. Even if no black is left in the finished surfaces, yet large flanges may come out uneven in thickness, resulting in the uneven projection in the bolt ends through the nuts on assembly. This is unsightly, yet it is by no means a cheap matter to take them all out and reduce the lengths to match. And again, the twist will probably result in a widely differing depth of cut in different places of the same flange, and this may so vary the spring of the work and the tool under the cutting force that an extra straightening cut will be necessary. When feet on a casting are in the same plane and properly at right angles to the flanges to be machined, the casting can often be sufficiently accurately set by simply sliding it round slightly on the machine table.

Patternmaker's Part.

Dealing with tool clearance, the lecturer said that it was very desirable for the patternmaker and the foundrymen to know just how it was proposed to machine a casting, for it must be remembered that the cutters of machine tools describe very definite and limited paths, and it sometimes happens that certain parts which it is not desired to machine will obtrude themselves into the path of the tool, or foul some part of the apparatus on assembly so that extra machining or fitting is necessary. Doors of such things as condensers, coolers, etc., often have ribs cast on the inside. Some of these ribs must make a watertight joint against corresponding ribs in the body to which the cover is bolted, while the others are merely to add stiffness and should not project into the plane of the joint. An excellent machine for a job like this is the H & V Planer.

Machining Notions.

Speaking of chambered designs, he said that in these cases the cores should be big enough to carry the metal clear of any tool or parts which is to be passed through the bored holes at the ends. Sometimes it is not realised how much is to come off in machining, and the moulder fails to keep the rib clear of the holes as machined. Core recesses are sometimes formed with a view to reducing the machining time, but it should be remembered that if the job is to be planed the overtravel of the tool may make it futile to use anything but long strokes straight across, so that the coring only served to double the shocks to the tool without saving any time. Owing to cast iron being so very much stronger in compression than in tension, there is always a tendency for it to break away as the tool leaves the metal in machining, and the deeper the cut and the greater the feed the worse will be the effect. One method of reducing this, without altering the effective cut of the machine, is to arrange the two tools in tandem so that the cut is divided between them. The other way is for the moulder to form a chamfer at the edge of the machining allowance. Castings have to be gripped before cuts can be taken across them, yet it often happens that the hammer and chisel or even an extra machining operation has to be resorted to to provide flats which can be gripped by the chuck jaws or the clamp ends on other machines. Spider studs are also sometimes deprived of the necessary purchase, and special steps have sometimes to be cut for them. A very much appreciated kindness on the part of some foundrymen is to cast a steel or wrought-iron plug in the centre of the bottom of closed cylinders, such as hydraulic cylinders, for the purpose of giving the turner a steel centre, which wears very much less than a centre cut into the cast iron itself.

Discussion.

MR. A. G. HARRISON remarked on the exceedingly low percentage of "scrap" which he had been informed was the rule in the engine works with which Mr. Dresser was connected, and was led to believe that the defects cited in the Paper were not all found there. He suggested that many of the points raised concerned the pattern shop even more than the foundry. Engineers were sometimes hard to please, as when the foundryman gave a casting which was easy to machine, they complained of its being porous or *vice versa*. He thought that the principle of giving the machine man just the kind of castings he fancies could be much overdone.

In reply, MR. DRESSER was glad to confirm the excellence of the castings produced in the works mentioned, and stated that the points raised in the Paper had been suggested by castings seen in many different works. He certainly wished to include the pattern shop in the discussion, and with regard to the last point, he would utterly condemn any attempt to save 9s. in the shops at the expense of 10s. in the foundry.

MR. HARROD was interested in the point about the gear wheels, as he had recently been with a firm of well-known gear specialists. He said

(*Concluded on page* 338.)

Moulding and Casting.*

By J. Ellis (Past-President of the Institute of British Foundrymen).

Wonderful opportunities exist to-day for the juniors to advance in the higher branches of the craft, opportunities which were unheard of a few years back, and perhaps unthought of. Foundry literature was very scanty; a few books were in print, but they were of such a character as to render them almost useless to the average foundryman. Meetings of foundrymen were non-existent; the only gatherings, very slightly approaching them, were those which were held in the local public-house, where the moulders and coremakers and others used to foregather for their evening's refreshment and chat about the work in the foundry. I believe those meetings were the forerunners of the idea of co-operative study.

The year 1902, when The Foundry Trade Journal was first published, was of outstanding importance; this provided the opportuity so much desired by the trade, and the opportunity was very quickly embraced, for in the second issue there appeared a letter urging the formation of an Association for foundrymen. For the next two years letters appeared supporting this, until, in 1904, seven foundrymen met in a small back room of an hotel in Birmingham and actually founded the "British Foundrymen's Association" (now the Institute of British Foundrymen), and from that small beginning to-day it numbers nearly 2,000 members.

I will take you back in thought over 50 years and ask you to consider the great difficulties with which the moulders had to contend as compared with the conditions prevailing to-day. With all the splendidly improved plant and machinery, great advance has undoubtedly been made during that period.

Facing-Sand.

It is of vast importance that facing-sand should be mixed and made correctly for each job; one would not think it necessary to emphasise this point, yet it is necessary, for recently the author has been called into consultation on several occasions to investigate the cause of defective castings, proved eventually to be due to the facing-sand. On one occasion several castings were placed out for his inspection, and it wanted only a cursory glance to diagnose the cause. The foundry was provided with a facing-sand mixing plant, consisting of quite a satisfactory arrangement—a good sifter, mill and mixer, yet not one was in use. The reason given was that each moulder mixed his own facing-sand, and as they were all piecework, one can readily understand what was happening—just a bit of new sand, black sand and coal dust, turned over with a shovel and then sifted through a ¼-in. mesh sieve on to the pattern. There were lumps of new sand on the face of the mould in places, while in other places there were patches of dry sand which could easily be washed away; small wonder that the castings were bad. It is not desired to imply that moulders do not know how to mix facing-sand, but it is stressed that unless the operative is a skilled worker, it is not sound practice to allow each worker to perform such work.

It is unwise to give a mixture of facing-sand for all uses; each class of work requires a special treatment. If a foundry is employed in making one line of castings only, then it becomes an easy matter to produce a facing-sand best suited to that class of work.

It is within living memory that facing-sand was made without the aid of machinery; quantities were gathered on an iron-plated floor, then mixed with a shovel and sifted through a ½-in. sieve, then water was added until the operative was satisfied as to the correct dampness. The sand was then spread out about 6 in. deep over the floor and walked upon; at each step the man would twist his foot, giving a milling effect. This operation would continue for about 10 or 15 minutes, and then the whole lot was sifted through a ¼-in. mesh sieve, put into a bin and was then ready for the moulder. Now to-day there are elaborate plants which will deal with tons of facing-sand per hour. This is one very distinct advance; of course, it is not every foundry that can afford to buy this expensive machinery. Some foundries can and do turn out real good castings with only a sifter, mill and mixer, in fact some who have only a mill are doing good work. So much depends on the human element.

Preparing Facing-Sand.

The ideal method of mixing facing-sand is, no doubt, as follows:—All sand to be thoroughly dried (this involves special drying machinery), then measures for exact quantities of new sand, black sand and coal dust. The whole is mixed, say, by a worm conveyor, along which sprays of water are added, giving the correct moisture. Then the milling, sifting and mixing is carried out in the usual manner. This facing-sand is for green-sand work.

For dry-sand work this elaborate machinery is not so necessary, although in large works where large quantities of this sand are used, it is profitable to have a good system of mixing and preparing. For heavy, dry-sand work, a good mixture is made up of dried loam treated in the usual manner; moisture can be added rather more than in the case of green-sand work, because the moulds are to be dried and all the moisture driven off. There is a distinct advantage in having this dry-sand facing with more moisture in it; it works up better in moulding, gives better lifts, and is more easily finished. In one foundry, where the green-sand moulders were supplied with facing-sand ready for use, one moulder in particular frequently turned out his castings with blow-holes in them, while all the other moulders using the same facing-sand turned out sound castings. The moulder said the metal was at fault and caused the blow-holes. After going into the question carefully it was discovered that this man always added a little more water to the facing-sand in order to get better lifts and make more moulds and thus earn more money, so it is obvious how vitally important it is to exercise a strict supervision over every operation of moulding.

Facing-sand is perhaps the one factor more than any other which needs great care; if it is correct many foundry troubles will cease. Bad strips, scabs, mapping, blow-holes, dirty streaky veins, are all due to badly-mixed facing-sand.

Ramming.

There is a very great art in ramming; this—like many other operations in moulding—can only be acquired by practice. The difficulty in machine-rammed moulds is that they all have to be supplemented by hand-ramming more or less; whether it is between the hooks, under the stay bars, or a dog or flat ram on top. Even so, the author believes there is no machine that will ram a mould as well as a moulder. Everybody knows that some moulds require to be rammed hard in some places, while in others they must be a little softer, and only a moulder can do this; he feels the hardness and softness of the mould with each stroke of the rammer. Do not think for a moment that by the installation of moulding machines all troubles and wasters will be eliminated. Certainly, most machines relieve the moulder of the hardest part of moulding, and in this respect they are certainly labour-saving devices. Great care and discrimination must be exercised in selecting and installing moulding machines. In one foundry there were 17 moulding machines installed, and at one period not one of these was in use. The reason given was that the work for which they had been installed had been withdrawn, because the user of the castings demanded a reduction in price. In this case the foundry had gone to the expense of buying, installing and maintaining these machines, and the user wanted the entire benefit.

Hot and Dull Metal.

Generally speaking, the author has had the best results when moulds were poured with hot metal. A curious personal experience relates to a breakdown job which arrived one afternoon when the blow was well under way; it was for hydraulic purposes, and had to be subjected to high-pressure water test. As many men were put on this job as could conveniently be got round it, and it was hoped to get it ready for the last tap. However, unfortunately, or fortunately, it was not, so that the metal was held back in the cupola. When all was ready and the metal was tapped out, it was very dull and sluggish. However, the management chanced it, and just managed to fill the mould by forcing in the metal. When the casting was machined and tested it proved to be one of the best ever made. The author took up this matter with a very eminent Professor of Metallurgy, and he said that if the metal could be held back and cooled down so that it would just fill the mould, good castings would result. The author still disagrees, having lost many castings through dull metal, and the best results have been continually obtained when the moulds were poured with hot metal.

(*To be continued.*)

* A Paper read before the Scottish Junior Section of the Institute of British Foundrymen.

The Cost of Defective Castings.

(*Continued from page* 337.)

how difficult it was to avoid the type of blow-hole mentioned in the Paper, especially in the vicinity of H-section arms, though cruciform arms were not so bad. He added that chambered cores had a tendency to cause porosity of the metal of the boss.

Mr. C. B. McCurker thought that some of the requirements of the machine shops were rather contradictory, and that it would be necessary for the patternmaker and the moulder to know how castings were to be machined before they could produce just what was wanted. He considered that the subject of co-operation between the machine shops and the foundries was well worth a whole evening's Paper and discussion.

Mr. Dresser, in replying, agreed that co-operation was the key to the solution of most of the difficulties mentioned, and remarked that much could be done by tactful officials whose province covered both departments, and contrasted that method with the practice in some large works of holding "inquests" attended by numerous officials and inspectors, followed by reports and managerial kicks.

The Chairman (Mr. Ridsdale), in closing the discussion, commented on the great value of "round table" conferences such as this. With regard to the avoidance of blowholes in cylindrical castings, he said that the use of "pencil runners" had been very effective.

Cold Crushing Strength of Firebricks.—Mr. H. K. Mitra, in the Journal of the American Ceramic Society, recommends that in order to determine their cold crushing strength, firebricks should be tested on end. A capping material consisting of a mixture of sand and molten sulphur was found more suitable for the crushing tests than any of the materials hitherto used for this purpose.

Institute of British Foundrymen.

ANNUAL BUSINESS MEETINGS HELD.

West Yorkshire Branch.

The fifth annual meeting of the West Riding of Yorkshire Branch was held at the Bradford Technical College under the presidency of Mr. W. G. Thornton (Bradford), who was completing two years of office.

Secretary's Report.

MR. S. W. WISE (hon. secretary), in his annual report, said he felt the Branch could congratulate itself on having passed through a successful year—a surprisingly successful year, perhaps, in view of industrial conditions and the state of the engineering trades generally. The winter session had been a particularly interesting one in lectures and works visits, and the interest of members had been very well maintained throughout. New members had not come along quite as well as had been hoped. Some new members had been elected, but there had been one or two losses, one, unfortunately, by death, and some by removal or other causes. Comparing the membership with that of the year 1926, there was a net gain of five—quite a good position having in mind the fact that in that year quite a number of members joined in the enthusiasm of novelty and afterwards fell away. The membership to-day numbered 83, of whom 22 were in the Bradford, Shipley, Bingley area; 14 in the Huddersfield district; 14 in Leeds and neighbourhood; 9 in Keighley district; 8 in Halifax; 6 in York; 4 in Sheffield; 1 each in Wakefield and Hull, and the remainder of single individuals in various other areas—including one now in the Persian Gulf, which was not yet a part of Yorkshire, but who specially desired to maintain his membership contact with his Yorkshire colleagues. The full membership was 34 and the associate membership 49.

The financial position was fairly satisfactory, the bank balance being slightly less than last year. All meetings and gatherings arranged for in the year's syllabus had been carried out and there had been three very interesting works visits during the session. The lectures and Papers had been of great interest and of a high standard of quality, and it was gratifying to know that members of the Branch itself, who had contributed Papers, had acquitted themselves very creditably. The Branch had decided definitely on a policy of encouraging its own members in this regard, and the results achieved proved that that policy was amply justified, though they were always glad, of course, to welcome a visiting speaker from other areas. Though not able to welcome into Yorkshire the American foundrymen visitors who came to this country, the Branch had taken an interest in the proceedings of the recent International Congress and had taken its share in raising the funds necessary to secure proper hospitality for the visitors. The sum of £5 had been voted from the Branch funds and an additional £5 had been raised by members' personal contributions, making a total of £10 from the Branch.

Membership Considerations.

The area covered by the activities of the West Riding of Yorkshire Branch was a very extensive one—even extending to York and the East Riding—and the difficulty of adding to the membership, like that of attendance at meetings, was largely one affected by considerable travelling distances involved. The Branch, nevertheless, hoped to maintain its policy of propaganda in suitable quarters, with a view to adding both to membership strength and the attendance numbers, which under all circumstances were consistently good. The policy generally pursued by the Council had been to attract new members by the results of the work done in the Branch rather than attempting to increase membership by more artificial means, and they believed this would prove to be a course resulting in the maintenance of more solid interest. If they did not make a large number of new members each year they had the satisfaction of knowing that they were maintaining the interest and loyalty of those already made, and were slowly and steadily adding. Of the members made during the past five years, they had lost only two associates and two associate members. They had, unfortunately, lost a very staunch and valuable supporter by the lamented death of the late Prof. Charnock, former head of the Engineering Department at Bradford Technical College.

New Officers Announced.

The following officers were elected for the coming working year:—

Branch President, Mr. H. Sayers (Leeds); senior vice-president, Mr. A. S. Worcester (Huddersfield); junior vice-president, Mr. R. D. Welford (Bradford); secretary and treasurer, Mr. S. W. Wise (Bradford)—who was warmly thanked for his services during the year and congratulated on his recovery from serious illness; Council: Messrs. L. Farrar (Shipley), H. Holdsworth (Bradford) and W. Hawley (Brighouse), all for three years, and Mr. A. Lowe (Keighley), for one year, in the place rendered vacant by Mr. Welford's elevation to vice-presidency.

Mr. A. S. Worcester was re-elected Branch representative to the General Council of the Institute, and tribute was paid to his work on that body by Mr. Thornton and Mr. Wise. Messrs. R. D. Welford (Bradford) and W. Hird (Bingley) were re-appointed honorary auditors, and Messrs. H. Forrest and Stanley Wise were appointed joint librarians and registrars to the Branch.

A vote of thanks was carried to the retiring President and members of Council (Messrs. Hird, of Bingley, Wass, of Shipley, and Blair, of York), and responded to by Mr. Thornton, ex-President.

Tentative proposals for continuance of gatherings during the summer included a proposed excursion to York, for members and their ladies, and a hope that a visit to the works of Messrs. Adams, engineers, might be included.

Birmingham, Coventry and West Midlands Branch.

The annual meeting of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen was held recently at the Chamber of Commerce, Birmingham, Mr. E. H. Tyson, retiring Branch-President, was in the chair at the opening of the proceedings.

Reviewing the past session, the HON. SECRETARY (Mr. F. K. Neath) said there had been considerable activity in the Branch. Five lectures had been given in Birmingham, two at Coventry and one at Dudley. The average attendance at the Birmingham meetings was 36, and works visits had been well patronised. The membership of the Branch was 238; during the year 42 new members were elected and 6 resigned. The Junior Section had not been so successful. There was a considerable falling-off in membership, and a fresh attempt was to be made to quicken interest in the section. Mr. Neath directed attention to the convention to be held at Birmingham in June, 1931, when Mr. A. Harley, of Coventry, would be the President of the Institute. He added that the accounts showed a total subscription income of £260 8s.

The report and accounts were adopted.

On the proposition of MR. TYSON, seconded by MR. H. J. ROE, Mr. D. Wilkinson was elected President.

MR. TYSON expressed his thanks to the Branch Council and the secretary for the support and help he had received during his term of office.

MR. WILKINSON then took the chair, and, in thanking the members for his election, said they all considered the Birmingham Branch to be one of the most important in the Institute. Referring to the Junior Section, he urged those in a position to influence apprentices capable of profiting by membership of the section to take a strong stand in urging them to join. The junior branch would feed the senior branch, and it would also be an advantage to the young men themselves. They would become better men and better workmen.

Capt. F. J. Hemming, joint managing director of F. H. Lloyd & Company, steel founders, Wednesbury, was appointed senior vice-president, and J. G. Pearce, director and secretary of the British Cast Iron Research Association, junior vice-president. Mr. F. K. Neath was re-appointed hon. secretary and treasurer, and Mr. L. W. Bolton was asked to serve as assistant secretary. Messrs. J. H. Westwood, M. H. Curnow and E. S. Morgan were re-elected to the Branch Council, and Mr. W. Baker was appointed to fill a fourth vacancy. Messrs. F. J. Hemming, J. B. Johnson, H. J. Roe and W. J. Flavell were elected delegates to the General Council of the Institute.

A discussion took place on the subject of the night of meeting. Thursday and Friday were both equally favoured, and the secretary was also empowered to fix meetings on Saturday when it was necessary to meet the convenience of lecturers. A vote of thanks to the retiring President, the secretary, Council and delegates for their services during the session was heartily accorded.

The President offered a welcome to Mr. W. Main, of Melbourne, and invited him to speak.

MR. MAIN, responding to the invitation, said that while in Australia the number of foundries was small compared with the old country, they had been started, probably, by English and Scottish foundrymen, and the work produced compared very favourably with what he had seen during a recent visit to America.

The business proceedings at an end, MR. D. H. WOOD addressed the members on the subject of the "Poumay Cupola."

Lancashire Junior Section.

The annual general meeting of the Junior Section of the Lancashire Branch was held recently at the Manchester College of Technology. The balance-sheet showed an income of £34 12s. 3d. and an expenditure of £30 0s. 11d., leaving a surplus of £4 11s. 4d. MR. R. YEOMAN and MR. A. BURGESS, joint secretaries, presented the report upon the year's working. It recorded two works visits during the summer, one to Messrs. Green's Economiser Works at Wakefield, the other to Messrs. H. Wallwork & Company (1920), Limited, iron-founders, Red Bank, Manchester. Mr. F. L. Topham won the John Wilkinson Medal, Mr. E. Garside the Robert Buchanan Memorial Medal, and Mr. E. Sutcliffe Mr. Jolley's prize in the short-Paper competition. This competition, Mr. Yeoman observed, showed there was debating ability amongst the members, and greater willingness to display it. Lectures were given by Mr. Key ("Production of Large Castings by Modern Jolt-Ramming Methods"), Mr. Phillips ("Cupola and other Foundry Data"), Mr. Gray ("Foundry Costing"), Mr. Wharton ("Mass Production from Cheap Plant") and Mr. A. Sutcliffe ("Jobbing Moulding"). The average attendance was about 50.

MR. R. A. MILES, retiring President, said his successor, Mr. A. L. Key, was like himself a past-President of the Senior Section. So long as the members of that body took an interest

in the Junior Section there was little fear of it declining, but efforts should be made to enlarge the membership. He was sure many appreciated the benefits they had derived from it, and they should make it known to others.

Mr. Key said he believed in encouraging and helping the juniors in the industry and hoped, with the help of the Council, to make the session an interesting one.

Mr. H. B. Grundy was elected vice-president and Messrs. R. Yeoman and A. Burgess were re-elected joint secretaries.

Middlesbrough Section.

At the annual meeting of the Middlesbrough Branch of the Institute of British Foundrymen an increased membership and greater enthusiasm in branch affairs was reported.

Mr. N. D. Ridsdale, the retiring President, presided over an excellent attendance, and in his annual report the Hon. Secretary (Mr. F. A. Harper) said that, although the membership of the branch was about the same as last year as regards numbers, the branch was in a far stronger position. During the past year there had been considerable pruning among the members, and to-day their membership was 70 as compared with 67 last year. They were 90 per cent. active members.

The Chairman at this point said that the attendances at the monthly meetings had improved considerably and the condition of the branch generally was very gratifying.

In his financial statement the Assistant Hon. Secretary said the expenses of the Middlesbrough Branch were the lowest of any branch in the Institute. Subscriptions had been received in a very gratifying manner, and it was hoped they would reach a total sum of £157. The reports were adopted, and the Secretary gave details of the arrangements that had been made for the 27th annual convention in Middlesbrough in June.

Conference Programme.

The convention, he said, would be opened on the evening of June 17, when the visitors would be received at the Technical College by Mr. William Shaw, their new Branch-President, and Mrs. Shaw. The annual banquet and dance will be held in the Constitutional Hall on the following evening, and it is expected that a very distinguished gathering will be present. A lengthy and very interesting social programme has been arranged, and this will include daily visits to some of the works on Tees-side. The Tees Conservancy Commission have consented to take the visitors down the river, and one whole day will be devoted to a pleasure drive over the moors to Whitby, returning by the coast route and calling at Saltburn in the evening, where the foundrymen will be entertained by Mr. and Mrs. Shaw at a garden party in the grounds of their residence, "Overdene." A souvenir handbook descriptive of the works and products of Tees-side, the beauties of Cleveland and of the nearby seaside resorts will be presented to each delegate.

After a vote of thanks to the retiring officers had been proposed by Mr. S. P. Thorpe, Mr. William Shaw was elected President, Mr. A. G. Harrison was elected senior vice-president, and Mr. S. P. Thorpe was made the junior vice-president. The secretary and treasurer were re-elected.

Dr. Ingall and Mr. Mercer were elected to serve on the Council, and the retiring members on this Council were re-elected. On relinquishing his office as President, Mr. Ridsdale spoke of the great progress the branch had made during the past few years.

Messrs. Dorman, Long & Company, Limited, Middlesbrough, have decided to blow out one of the two furnaces at their Newport Ironworks at present making basic pig-iron.

French Foundry Students' Easter Tour.

Students of the Paris Foundry High School, accompanied by their directors, Mr. E. Ronceray and Mr. R. Lemoine, spent an interesting vacation course during the first part of the Easter holidays in the industrial district in the French Midlands.

Leaving Paris on the evening of April 11, they arrived early the next day at Lyon and were taken by motor car to the Usines de la Verpillière, where they were received by Mr. Mital and Mr. Marron, and visited the modern and well-known light-castings foundry. The two partners have appreciated the basic importance of rational organisation; all the moulds are made by machine and mechanically handled; the distribution and preparation of the sand is automatic and casting is continuous. The students appreciated the large range of aluminium moulding boxes in use, which, whilst incorporating lightness and rigidity, also ensure a marked increased production of castings.

The afternoon was devoted to a visit to the blast furnaces of Chasse, under the guidance of Mr. Demoule, director, and Mr. Poulet, foundry manager. The students watched all the operations, from the tapping of the blast furnaces to the manufacture of slag briquettes and the distillation of benzol. They were specially interested in the power station where the 1,200 h.p. generators use blast-furnace gas.

On the following morning a visit was paid to the Usines and Seguin (Paris-Lyon-Mâcon). Mr. Regnier gave full descriptions of the iron and bronze foundries, and, in particular, of the Brown-Bovery electric furnace, which he himself had installed some years ago, and which has given complete satisfaction for the melting of steel.

On Monday a car of the Maison Berliet brought the visitors to the foundry of this works, where they were greeted by Mr. Babée. They appreciated the intelligent control of the core department and its stoves, and watched the assembling of several motor-car cylinders.

Before finally leaving Lyon, the students inspected the works of the P.M.L. Railway Company at Oullins, where Mr. Peyrot, a former student of the Foundry High School, met the party. They visited the pattern stores, which is a vast reinforced-concrete building containing over 70,000 patterns, valued at £13,700. Full steps have been taken to avoid a fire. The Grinnel system is installed on all the floors and the stores are capable of being flooded automatically as soon as the temperature exceeds 70 deg. C. A splendid indexing of the patterns allows them to be rapidly identified, thus saving considerable loss of time. The iron foundry is very old, and shortly will be replaced by a new plant, which is already in the course of construction. The students were present at the remoulding and casting of a locomotive cylinder, and in the bronze foundry they admired the castings made in green sand.

Arriving at Saint-Etienne on Tuesday morning, the students went to the steelworks of Firminy, where a cordial reception was given them by Mr. Eugrand, director, Mr. Granger, works manager, and Mr. Bouvard, malleable-foundry manager. The works are organised on the American methods and is a good example of the utilisation of conveyors and of continuous casting. The moulding of large castings of ordinary iron and of steel, especially of anvils, attracted much attention. Finally they returned to the steelworks, where they saw the tapping of a Siemens furnace.

The party then divided, in order to visit two local collieries. Later the party reunited at Saint-Etienne to inspect the local School of Mines, where Mr. Descombes and Prof. Chevenard (who lectures on the "Dilatometry of Alloys" at the Foundry High School) acted as chaperones.

The students left Saint-Etienne early the next day for Saint-Chamond, where they were received at the Aciéries de la Marine by Mr. Roederer, director, when, under the conduct of Mr. Latour, steelworks manager, and Mr. Hanus, foundry manager, they visited the iron and steel foundries. Points and crossings, made in manganese steel, is a speciality of this firm. They watched the tapping of one of the electric furnaces, a Héroult type of 10 tons.

After a luncheon the students went on to Assailly, where they inspected the other works of the Aciéries de la Marine, Mr. Cluzaud, the manager, himself directed the visit and detailed the basic principles of production, its rationalisation and time studies. The operation of rolling clearly proved the application of this principle, which had brought about an appreciable saving in addition to saving of time, the discovery of the cause of stoppages and their remedy. The inspection included a battery of Héroult electric furnaces, where there was seen operating an excellent system of the automatic electrode control.

After the visit to the steel foundry, where the application of time studies was observed, refreshments were served. Mr. Ronceray, on behalf of the Foundry High School, thanked the directors for their kindness.

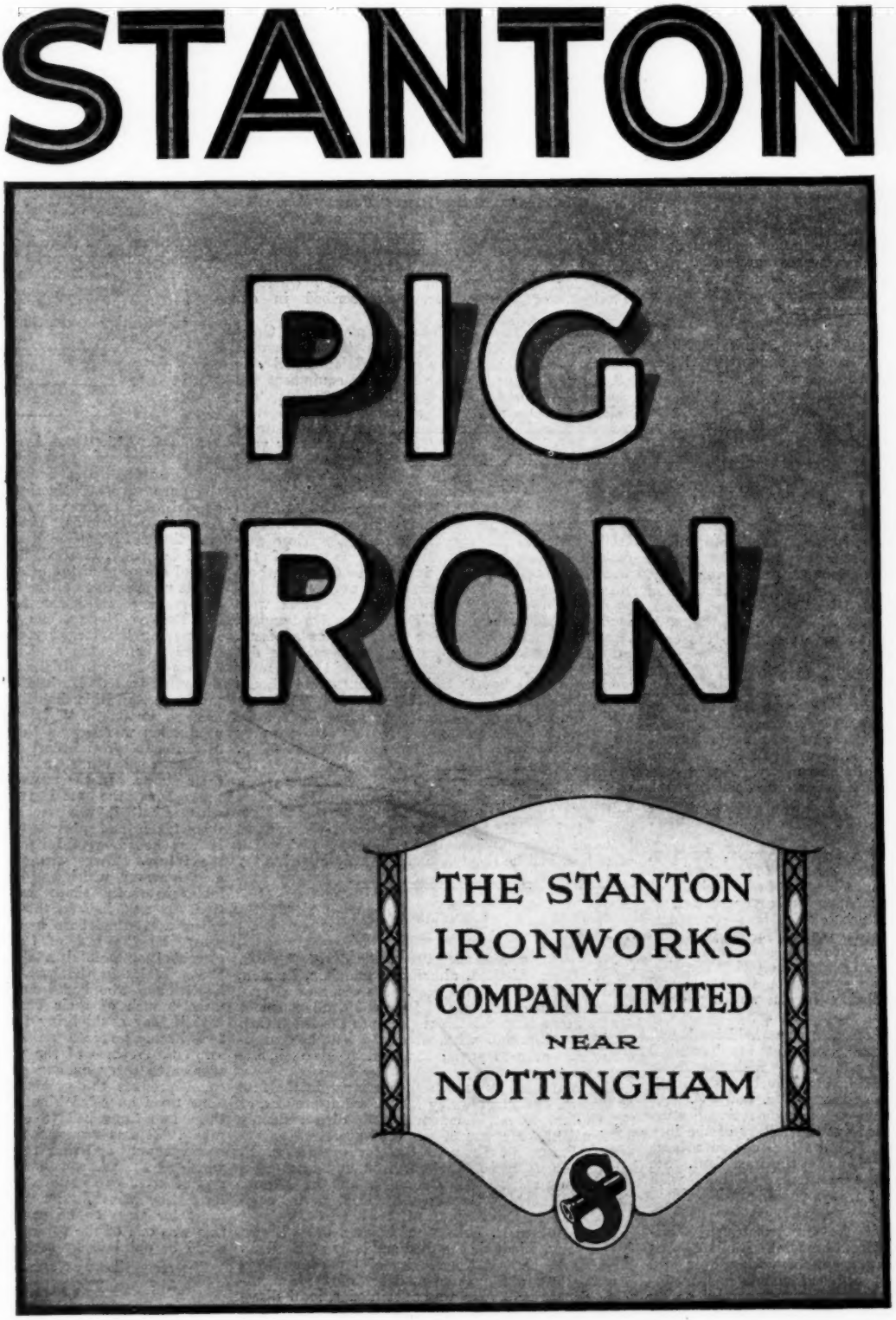
Analysis of Breakdowns to A.C. Motors in 1929.

In accordance with their usual custom the Vulcan Boiler & General Insurance Company, Limited, have published the analysis of breakdowns which occurred to dynamos and electric motors under their inspection and insurance during the year 1929. We reproduce below a table relating to alternating-current motors.

Breakdowns of Alternating-Current Motors.

Description of parts which failed.	Slip-ring.		Squirrel-cage.	
	Percentage number of breakdowns.	Percentage cost of breakdowns.	Percentage number of breakdowns.	Percentage cost of breakdowns.
Stators ..	30.0	45.0	69.0	82.0
Rotors ..	31.5	40.0	10.0	8.5
Brush gear ..	9.0	2.3	—	—
Shafts ..	2.7	2.4	3.1	1.6
Starters ..	18.0	5.2	9.4	4.2
Bearings ..	3.4	3.7	5.4	2.5
Miscellaneous	5.4	1.4	3.1	1.2
	100.0	100.0	100.0	100.0

Stress and Corrosion.—At the recent annual meeting of the American Institute of Mining and Metallurgical Engineers, Mr. D. J. McAdam read a Paper on the "Influence of Cyclic Stress on Corrosion," in the course of which he discussed the influence of cyclic stress on corrosion of carbon and ordinary alloy steels, corrosion-resisting steels, Monel metal, and aluminium alloys. The damage due to corrosion was estimated by comparing the fatigue limit of the previously-corroded specimen with the endurance limit of the metal. Specimens were corroded with or without cyclic stresses of various frequency, and for various times. The corroded specimen was then oiled, its fatigue limit determined and compared with the endurance limit of the non-corroded material. The lowering of the fatigue limit represented the effect of corrosion. Even very low corrosion stresses had a noticeable effect in accelerating the damage due to corrosion. For steels and aluminium alloys, alternating stress of only 3,000 lbs. per sq. in. caused considerable net damage. Stress as low as 2,000 lbs. had appreciable effect. For corrosion-resisting alloys, stresses far below the corrosion-fatigue limits, as obtained by short-time tests, caused decided net damage. Tentative conclusion was drawn that any stress cycle, however small the stress range, accelerated corrosion pitting. The total damage to steels, when corroded with or without cyclic stress, proceeds at a gradually-decreasing rate. The total damage to "Monel" metal or corrosion-resistant steels, when corroded with or without cyclic stress, proceeds at a continually-accelerated rate.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Trade Talk.

A Royal Charter of incorporation has been granted to the Institution of Mechanical Engineers.

Valuable patterns were destroyed when a fire broke out at the ironfoundry of Messrs. Swift & House, Limited, Wigan.

Messrs. John Giles & Sons, Limited, malleable nail manufacturers, Ashton Gate, Bristol, are to establish a new factory in the North of England.

Messrs. A. & T. Burt, Limited, Dunedin, N.Z., have decided to reopen a London office, Balfour House, Finsbury Pavement, London, E.C.2, as from May 1, 1930.

Short time has been introduced in the St. Rollox Works of the L.M.S. railway. The works have been on full time for the past five months, but five days per week working has now been reintroduced, Saturday being an idle day.

Negotiations have been pending for some time betwen the Steelmakers' Association and the Steelworkers' Union for a new wages agreement. An understanding has been reached and is now in operation. The scheme as it affects the West of Scotland includes an overhead tonnage rate for the smelting departments.

The British Compressed Air Society, with an address at 76, Victoria Street, London, S.W.1, has been formed to promote and develop the interests of British air compressor, pneumatic tool and pneumatic appliance manufacturers. It will deal with all questions except those concerned with the relationship between employers and employees. It is stated that most of the leading manufacturers in the industry are members of the Society.

The members of the Crucible Steel Makers' Association held their annual meeting at Sheffield on April 29, and had under consideration the proposal of the Government to ratify the Washington (Hours) Convention. Mr. W. E. S. Patrickson was elected President of the Association for the ensuing year, and Messrs. J. H. Doncaster, C. W. Kayser and H. P. Marsh were elected Vice-Presidents. Messrs. L. Chapman, Robert A. Neill, R. W. Matthews, J. Rollin and P. Wardrobe were elected to the committee of management.

The business of Messrs. John Kenyon & Company (Sheffield), Limited, file and saw manufacturers and crucible steel makers, is being taken over by Messrs. Sanderson Bros. & Newbould, Limited. Reference to this development was made by the chairman of Messrs. Sanderson Bros. & Newbould at the annual meeting of the company. A new company is to be formed, known as John Kenyon (1930), Limited. Orders, it is understood, will be executed at the works of Messrs. Sanderson Bros. & Newbould.

The Staveley Coal & Iron Company, Limited, Derbyshire, have acquired the rights from American patentees for the manufacture in Great Britain of iron pipes by the sand-spun process, which it is claimed is one of the most efficient and economical methods of making modern pipes for various purposes. A large foundry is to be erected at Staveley, and work has been commenced on clearing the site. About 150 men are now engaged on the work, and the foundry will probably be in working order before the end of this year.

The Derby Society of Engineers held its fourth business meeting of the session at the Technical College, Derby, on May 5, jointly with the Notts Society and the East Midlands Branch of the Institution of Mechanical Engineers. Mr. Lewis C. Ord, consulting engineer, gave a lecture on rationalisation in industry, and pointed out the fallacy of the idea that combining inefficient units together on a basis of rationalisation would make them efficient. He said that economies that were possible with rationalisation were not always possible in individual units.

The company of Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, has been formed for the purpose of taking over and operating the business of ironfounders and manufacturers of refined pig-iron formerly carried on by Sir W. G. Armstrong, Whitworth & Company (Engineers), Limited. The capital of the company is £130,000, the whole of which is owned by the parent company—Armstrong, Whitworth Securities Company, Limited. The foundry plant and equipment is thoroughly up to date, and is capable of dealing with castings up to 35 tons for all classes of general engineering work. It also produces Armstrong, Whitworth refined pig-iron of guaranteed analyses. The works address is Close Works, Gateshead-upon-Tyne, and the registered office Scotswood Works, Newcastle. The London office is at Park House, 22-26, Great Smith Street, Westminster, S.W.1.

Orders recently received for foundry plant by the Constructional Engineering Company, Limited, Birmingham, show that the foundry owners in general are not unduly pessimistic as to the future of the foundry industry. Contracts received include the following:—Two No. 6 rapid-melting "Titan" cupolas, complete with fire bricks, spark arresters, etc., for South Africa; No. 6 cupola and complete melting equipment for Birmingham Corporation Tramways Dept.; No. 4 cupola for foundry extension for Liverpool; one 7 ft. 6 in., one 7 ft., and one 4 ft. cupola, complete with spark arresters, etc., for foundry extensions in Yorkshire; three No. 8 Titan "Poumay" cupolas and complete melting equipment for one of the Indian railways; one 7 ft. 6 in. and one 5 ft. Titan "Poumay" cupolas, etc., for a new foundry in the South, and two No. 6 Titan cupolas with complete equipment for foundry in the Midlands. It will be recalled that this firm recently supplied the whole of the melting equipment for the new foundry of Messrs. Qualcast, Limited, of Derby, recently described in our columns.

Mr. Saul Bron, trade representative in Great Britain of the U.S.S.R., stated in the course of a recent speech that in a similar official capacity in the United States last year he placed equipment and constructive orders amounting to $95,000,000. The failure to place such a large amount of business in the United Kingdom was largely due to the state of Anglo-Russian relations. They were perfectly willing to do their best to correct this attitude provided they had the necessary interest and co-operation of British industrialists and responsible people. He pointed out that during his stay in the United States some two thousand Russian engineers and industrialists visited that country to study American conditions. There was no important centre of the United States and no important factory where Russian engineers and technicians were not studying something. Only five Russian engineers were studying in this country. There were five hundred American engineers working in Russia as advisers, as managers and as consulting engineers. He did not know how many there were from this country working in the Soviet Union. Going on to discuss actual business placed in this country, Mr. Bron said that in the first three months of their fiscal year, which began on October 1, they placed orders for British-made goods to the extent of £900,000. In the last six weeks they had placed orders for British goods amounting to £1,800,000. That was a modest beginning; their ambitions were far greater, and their appetite, as a new country in the making, was very big. He had at his disposal at the moment between fifteen and twenty million pounds' worth of orders, and he thought that was only a beginning.

Obituary.

Mr. Robert William Coan, head of Messrs. R. W. Coan, Limited, aluminium founders, London, died recently in his 67th year. He was a prominent member of the Institute of British Foundrymen.

Mr. John Orr, mining engineer to the Alloa Coal Company, Limited, with whom he had been associated for over 30 years, has died at his residence at Alloa.

Mr. Malcolm Bowley, senior partner in the firm of Messrs. Malcolm Bowley & Son, metal brokers, of 22, Cullum Street, London, E.C.3, died suddenly on April 21. He was 67 years of age.

Mr. Peter M. Lang, a director of Messrs. P. MacCallum & Sons, Limited, iron and steel merchants and shipowners, Greenock, and of Messrs. John G. Kincaid & Company, Limited, marine engineers, died on Saturday, April 26, aged 53.

Mr. Maurice E. Unwin, of Messrs. John Brown & Company, Limited, has died suddenly at Reading. Mr. Unwin entered the service of the company in March, 1898, and became manager of the armour-plate department. He was appointed a local director of the company in August, 1919, and latterly was acting as works manager.

The death occurred, on May 2, at his residence in Paisley, of Mr. John H. Wilson, who was a director and foundry manager of Messrs. A. F. Craig & Company, Limited, engineers and ironfounders, Caledonia Works, Paisley. Mr. Wilson, who had been unwell for some time, was well known in Scottish foundry circles, and was chairman of the Scottish Ironfounders' Association.

Personal.

Captain H. J. Kennard, R.N. (retired), managing director of the Falkirk Iron Company, Limited, has been appointed a Deputy Lieutenant of the County of Stirling.

Mr. D. A. Palmer has been appointed managing director of Messrs. Joseph Rodgers & Sons, Limited, Sheffield. Mr. Palmer has been general manager of the company since 1926.

Wills.

Rowe, George, managing director of the Upper Forest & Worcester Steel & Tinplate Works, Limited, Swansea ... £65,786

Arnold, Professor John Oliver, F.R.S., Emeritus Professor of Metallurgy in the Sheffield University £115

Cook, William, of Edgbaston, Birmingham, managing director of Messrs. William Cook (Birmingham), Limited, nail and tack manufacturers £37,021

Wood, John, of Hathersage, Derbyshire, late of Messrs. John Wood & Sons (Wisewood), Limited, Wisewood Forge and Rolling Mills, Sheffield £11,232

Company Meetings.

Baldwins, Limited.—A meeting of the holders of the first mortgage debenture stock of Messrs. Baldwins, Limited, was recently held in London for the purpose of considering a resolution approving a provisional agreement made between Messrs. Guest, Keen & Nettlefolds, Limited, Baldwins, Limited, and the British (Guest, Keen, Baldwins) Iron & Steel Company, Limited, for the transfer to the last-named company of the heavy iron and steel branches of the undertakings of the two companies first named and making certain modifications in the trust deed. Sir Robert Horne, one of the trustees, presided. In moving the formal resolution, he said that the business before the meeting arose out of the conditions of trade in this country, and particularly of the steel trade. During the war the capacity for production in this industry was very greatly increased, so that in times of peace the machinery for production was beyond the consuming requirements of the country, and steel companies were competing against each other in the endeavour to employ their plants. In the result there were serious losses throughout the steel trade. Last year Baldwins, Limited, was reconstructed, and the steps then taken had proved thoroughly justified, and, it was hoped, would be increasingly beneficial in the future. There was one branch of their business, however, which had been suffering considerable losses in recent times, even since the reconstruction. It was, in fact, the only part of the business where a loss had been incurred during the last two years, all the rest of the business being at the present time profitable. They had a neighbour in South Wales in the great firm of Guest, Keen & Nettlefolds, who had been incurring a loss on the same branch of their business. It had been felt that if they could bring the heavy branches of the two businesses into an amalgamation they could scrap those parts of the plant which they did not require to carry on and operate those parts which could produce the greatest profit. This could be done upon an establishment much less costly than these two firms had to employ while acting separately. It was proposed to do this by means of a new company and thus to get rid of a competition which at the present time was very costly to both and of benefit to neither. If rationalisation was to form the principle on which businesses of this character were to be conducted in modern times, this was one of the typical examples where benefits could be obtained by such a process.

The resolution was carried unanimously.

Catalogue Received.

Air Compressors.—The Drayton Regulator & Instrument Company, Limited, of West Drayton, Middlesex, set out in leaflet P 4 a line of small air-compressor sets and fittings, which they describe, illustrate and price.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Optimistic views of an early revival of demand for Cleveland iron, recently expressed in market circles, have by no means been confirmed by actual experience, and it must be frankly admitted that existing conditions hardly justify more cheerful expectations of improvement in the near future. The position, in fact, continues as unsatisfactory as it has been for the past few months, and unfortunately this observation extends both to home and export demands, which continue much below the normal seasonal average. For example, the April shipments of pig-iron from Tees-side ports only amounted to 14,345 tons, as compared with 20,208 tons in March, while, even with lower prices, Cleveland iron is still being undersold in the Scottish market. One influencing factor is the decision of the Midlands ironmasters to maintain the zone price. Beyond minor adjustments prices in other districts are unchanged, and Cleveland has therefore nothing to fear in this connection. Current quotations, which are uniform both for home consumption and for export, are :— No. 1 Cleveland foundry iron, 70s. per ton; No. 3 G.M.B., 67s. 6d.; No. 4 foundry, 66s. 6d.; No. 4 forge, 66s. per ton.

As recently expressed in these columns, the East Coast hematite industry has been for some time suffering from over-production, while stocks also have been accumulating. It has now been decided to limit outputs, and two furnaces have been put out of action during the past week. The ultimate effects will doubtless be favourable, but stocks are still so heavy that competition for orders is bound to be keen, and prices are still falling, quotations for mixed numbers now ruling at 74s. and No. 1 quality at 74s. 6d. per ton. On the North-West Coast Bessemer mixed numbers are quoted at 76s. per ton at works.

LANCASHIRE.—Though general disappointment has been expressed by local consumers of foundry pig that no price concessions have been obtainable from Midland producers, there has been a fairly active inquiry for supplies. These, however, have been for limited quantities extending over brief periods—in short, for no more than sufficient to meet immediate requirements. Prices may be repeated as follow :—Staffordshire No. 3, 77s.; Derbyshire No. 3, 77s., and 95s. for Scottish brands, all per ton delivered locally.

THE MIDLANDS.—So far as local markets for foundry pig are concerned, business shows no sign of improvement since the decision of the chief furnace owners to maintain prices unaltered was announced. Quotations therefore remain at the previous level of 75s. for Northants No. 3 and 78s. 6d. for Derbyshire and North Staffordshire No. 3. These figures include delivery to Birmingham and Black Country stations.

SCOTLAND.—Quietness prevails in the Scottish pig-iron trade both with founders and steel-makers. The resumption of work in England after the recent holidays has made practically no difference in the demand for pig-iron. The price of Scotch foundry remains unaltered at 78s. for No. 3, f.o.t. furnaces, the makers giving buyers no encouragement to expect a reduction.

Finished Iron.

At Birmingham the market for most grades of finished material remains quiet and uneventful so far as crown and nut and bolt iron is concerned. The makers are severely handicapped through lack of tonnage, and there is nothing like sufficient business maturing to keep the works in regular operation. Crown bars are offered at from £10 to £10 7s. 6d. and bolt iron from £9 to £9 7s. 6d. The works cannot get much support for the latter in view of the prevailing intense competition from abroad. This class of material is being offered freely here at about £6 per ton. The price for Staffordshire marked bars remains unchanged at £12 10s. at works. Business is a little quiet at the moment, but makers consider this to be just a temporary lull and that demand will improve.

Steel.

In the semi-finished steel department business has been irregular; but the British works continue to secure a good proportion of the orders passing in competition with the Continent. Conditions in the finished-steel department are reported brighter than of late, although they still leave a great deal to be desired. Stock replenishment orders have been rather more in evidence, and one or two of the overseas markets have been buying with a little more freedom. At Sheffield, makers of open-hearth steel are experiencing difficulty in disposing of their output, but there is a ready market for special steels. Siemens acid billets are in rather slower demand, but basic billet sales are very well maintained. Prices :—Siemens acid billets, £9 10s.; basic billets, soft, £6 10s.; medium, £7 12s. 6d. to £8 2s. 6d.; hard, £9 2s. 6d. to £9 12s. 6d.; acid wire rods, £12 5s. to £12 10s.; basic wire rods, soft, £8; medium hard, £9 15s. to £10; hard, £10 10s. to £11; steel hoops, £9 10s. to £10 5s. In the tin-plate market transactions continue on the basis of 18s. 3d. to 18s. 6d., coke quality, net cash, f.o.b. Welsh ports.

Scrap.

Markets for this class of foundry material continue dull and depressed, with prices generally tending to still lower levels. On Tees-side practically every quality of scrap has been marked down. Good ordinary heavy cast iron has been reduced to 59s. 6d. and machinery quality to 62s. 6d. In the Midlands cast-iron scrap appears to have steadied, 67s. 6d. being offered for machinery cast-iron scrap in cupola sizes, 65s. for medium and 62s. 6d. for light metal. In Scotland heavy machinery cast-iron scrap is quoted at 67s. 6d. to 68s. 6d.; heavy ordinary cast iron, suitable for foundries, 62s. 6d. to 63s. 6d.; railway chairs, 66s. 6d.; light metal, 55s. to 56s.; and old cast-iron firebars, 53s. 6d. to 54s. 6d., these prices being per ton delivered f.o.t. consumers' works.

Metals.

Copper.—The recent collapse of prices in the standard copper market has been continued unchecked during the past week, marking some of the lowest figures recorded since 1914. The slump is attributed to a large accumulation of metal in the hands of American producers, and, although consumers have little stock in hand, it will be some time before it can be reduced. Consequently cheap copper seems a certainty for quite a considerable time, and new enterprise should be stimulated, which in turn should improve the position of other metals.

Closing quotations :—

Cash.—Thursday, £50 15s. to £51; Friday, £51 to £51 2s. 6d.; Monday, £49 10s. to £49 15s.; Tuesday, £48 10s. to £48 12s. 6d.; Wednesday, £48 7s. 6d. to £48 10s.

Three Months.—Thursday, £50 7s. 6d. to £50 10s.; Friday, £50 12s. 6d. to £50 15s.; Monday, £49 10s. to £49 12s. 6d.; Tuesday, £48 7s. 6d. to £48 10s.; Wednesday, £48 2s. 6d. to £48 5s.

Tin.—Following the disclosure of the April statistics, standard tin values also experienced a heavy setback, declining on Tuesday to £142 7s. 6d. cash, the lowest price touched for many years past. The April figures show an increase in the total visible tin supply of 3,923 tons, while there are also 2,579 tons more in the East waiting to be shipped. Thus, the total available tin, including the Eastern "carry-over," is now 41,915 tons, compared with 35,413 tons at the end of March and 26,855 tons a year ago.

Official closing prices :—

Cash.—Thursday, £151 10s. to £151 12s. 6d.; Friday, £150 5s. to £150 7s. 6d.; Monday, £148 15s. to £148 17s. 6d.; Tuesday, £142 7s. 6d. to £142 10s.; Wednesday, £145 5s. to £145 10s.

Three Months. — Thursday, £153 10s. to £153 12s. 6d.; Friday, £152 7s. 6d. to £152 10s.; Monday, £150 15s. to £151; Tuesday, £144 5s. to £144 7s. 6d.; Wednesday, £147 to £147 5s.

Spelter.—The downward progress of zinc quotations continues, and the £16 mark has been reached. There has been a slight improvement in the demand from some works, but, on the other hand, the galvanising industry is depressed, and there has been a decline of activity on the part of sheet rollers.

Daily quotations :—

Ordinary.—Thursday, £16 12s. 6d.; Friday, £16 7s. 6d.; Monday, £16 5s.; Tuesday, £16; Wednesday, £16 2s. 6d.

Lead.—There is a general feeling of uncertainty in the lead market, and prices have fallen together with those of other metals.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £17 8s. 9d.; Friday, £17 5s.; Monday, £17; Tuesday, £17 1s. 3d.; Wednesday, £17 5s.

Students' Corner.

Q.—How many castings is it possible to obtain from a single metal mould ?

A.—From ordinary cast iron permanent moulds used to obtain density, soundness and freedom from porosity, hundreds of castings may be made from a single mould, providing reasonable care is exercised in their manipulation. If we include die castings, which relate to non-ferrous metals poured into metallic permanent moulds, then the production from a single mould may run into thousands.

Q.—For what uses are permanent moulds used ?

A.—Many uses are found for permanent moulds. Primarily, it is possible to obtain a large number of castings from a single mould ; secondly, denser and stronger castings are obtained from a metal permanent mould than from a sand mould ; and finally, the utility of a permanent mould is shown in many ways.

Q.—What are permanent moulds ?

A.—Permanent moulds are usually shaped from metal. There may be exceptions when a permanent mould may be made from some highly refractory material that will not easily crumble or break up into pieces.

Q.—How can it be ascertained that the metal cast in a permanent mould is stronger than metal cast in a sand mould ?

A.—By ordinary physical tests carried out on a testing machine, a sand-cast bar will give a tensile test per square inch of 11 tons, a permanent-mould bar will give a tensile test per square inch of 15 tons. This increase of strength is also shown with many of the non-ferrous metals cast in permanent metal moulds.

Q.—What is inferred by the term "the utility of the permanent mould" ?

A.—That the permanent mould, being a practical proposition, is commercially a success. Away back in prehistoric times permanent stone moulds were in use for many kinds of non-ferrous castings. To-day, take the common pile shoe with the wrought-iron fasteners cast on : when metal is available it is possible to make one per minute continuously in a permanent mould and the requisite hardness is imparted at the same time. Again, ingot moulds for liquid steel : these are iron permanent moulds. Also ingot moulds (open) used for remelts, and spare metals of various die moulds, etc. The utility of the permanent mould is endless.

Q.—Are permanent metal moulds expensive ?

A.—Whilst expensive as an initial cost, yet as a comparative cost they are not.

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LADLES,
FIRE BRICKS,
STONE FLUX,
CASTING CLEANERS,
PIPE NAILS,
SPRIGS,
WIRE BRUSHES,
BELLOWS,
CUPOLAS,
GANISTER,
LOAM AND SAND MILLS,
STUDS,
CHAPLETS,
BRUSHES,
CORE ROPES,
BUCKETS,
SPADES, Etc.

Write for Illustrated Catalogue on Blacking and Foundry Requisites.

CAST IRON FLANGED PIPES
2 in.—12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 52 & 53. MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

NETHERTON IRON
AND
N.B I.C BARS
(SOUTH STAFFORDSHIRE MARKED BAR—LION BRAND).
IN ALL QUALITIES, GRADES, SIZES AND SECTIONS.
ALSO MADE INTO
CRANE CHAINS, SLINGS, FORGINGS, Etc.
N. HINGLEY & SONS, LTD.
NETHERTON IRONWORKS, DUDLEY.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	48	7	6
Three months	48	2	6
Electrolytic	56	0	0
Tough	56	0	0
Best selected	56	10	0
Sheets	92	0	0
India	77	0	0
Wire bars	61	7	6
Do. May	61	7	6
Do. June	61	7	6
Ingot bars	61	7	6
H.C. wire rods	63	12	6
Off. av. cash, April	62	3	3⅜
Do., 3 mths., April	61	4	10½
Do., Sttlmnt., April	62	3	7½
Do., Electro, April	75	1	0
Do., B.S., April	68	10	3½
Do., wire bars, April	75	15	3
Aver. spot price, copper, Apr.	62	3	3⅜
Solid drawn tubes			13d.
Brazed tubes			13d.
Wire			9d.

BRASS.

Solid drawn tubes	11½d.
Brazed tubes	13½d.
Rods, drawn	10½d.
Rods, extd. or rlld.	7d.
Sheets to 10 w.g.	9½d.
Wire	9½d.
Rolled metal	9½d.
Yellow metal rods	7d.
Do. 4 × 4 Squares	7½d.
Do. 4 × 3 Sheets	8d.

TIN.

	£	s.	d.
Standard cash	145	5	0
Three months	147	0	0
English	146	5	0
Bars	145	10	0
Straits	144	7	6
Australian	143	7	6
Eastern	149	0	0
Banca	149	7	6
Off. av. cash, April	162	14	7½
Do., 3 mths, April	164	15	2½
Do., Sttlmt., April	162	14	9
Aver. spot, April	162	14	7½

SPELTER.

	£	s.	d.
Ordinary	16	2	6
Remelted	15	5	0
Hard	13	10	0
Electro 99.9	13	10	0
English	16	7	6
India	14	10	0
Zinc dust	22	0	0
Zinc ashes	4	0	0
Off. aver., April	18	1	11½
Aver., spot, April	17	16	4½

LEAD.

	£	s.	d.
Soft foreign ppt.	17	5	0
English	18	15	0
Off. average, April	18	6	9¾
Average spot, April	18	6	4½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	27	10	0
Do. V.M. ex-whf.	26	5	0
Rods	30	0	0
Boiler plates	24	10	0
Battery plates	25	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	40	0	0
Chinese	29	0	0
Crude	20	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	12	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	17	6
45/50%	11	10	0
75%	18	10	0
Ferro-vanadium—			
35/50%	12/9 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/2 lb. Mo.		
Ferro-titanium—			
23/25% carbon-free	9d. lb.		
Ferro-phosphorus, 20/25%	£16	0	0
Ferro-tungsten—			
80/85%	2/10 lb.		
Tungsten metal powder—			
98/99%	3/1 lb.		
Ferro-chrome—			
2/4% car.	£30	10	0
4/6% car.	£23	7	6
6/8% car.	£22	10	0
8/10% car.	£22	0	0
Ferro-chrome—			
Max. 2% car.	£33	10	0
Max. 1% car.	£37	17	6
Max. 0.70% car.	£39	15	0
70% carbon-free	11d. lb.		
Nickel—99% cubes, or pellets	£175	0	0
Ferro-cobalt	9/6 lb.		
Aluminium 98/99%	£95	0	0
Metallic chromium—			
96/98%	2/7 lb.		
Ferro-manganese (not)—			
76/80% loose	£11	15	0
76/80% packed	£12	15	0
76/80% export	£11	10	0
Metallic manganese—			
94/96%, carbonless	1/4 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	£	s.	d.
Finished bars, 14% tungsten	£0	2	2
Finished bars, 18% tungsten	£0	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{7}{32}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ⅛ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					3	2	6
Bundled steel and shrngs.	2	17	0	to 3	1	0	
Mixed iron and steel	2	17	0	to 2	18	0	
Heavy cast iron	2	17	0	to 2	18	0	
Good machinery for foundries	2	17	6	to 3	0	0	
Cleveland—							
Heavy steel					2	17	6
Steel turnings					2	11	0
Cast-iron borings					2	8	0
Heavy forge					3	12	6
W.I. piling scrap					3	8	0
Cast-iron scrap	2	19	6	to 3	2	6	
Midlands—							
Ord. cast-iron scrap					3	2	6
Heavy wrought					3	12	6
Steel turnings					1	15	0
Scotland—							
Heavy steel					3	0	6
Cast-iron borings					2	10	0
Wrought-iron piling					3	18	6
Heavy machinery					3	8	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	46	0	0
Brass	34	0	0
Lead (less usual draft)	15	0	0
Tea lead	11	10	0
Zinc	9	0	0
New aluminium cuttings	63	0	0
Braziery copper	43	0	0
Gunmetal	43	0	0
Hollow pewter	110	0	0
Shaped black pewter	80	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	70/-
Foundry No. 3	67/6
Foundry No. 4	66/6
Forge No. 4	66/-
Hematite No. 1	74/6
Hematite M/Nos.	74/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	85/6
„ d/d Birm.	94/6
Midlands—	
Staffs. common*	—
„ No. 4 forge*	73/6
„ No. 3 fdry.*	78/6
Shrops. basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	70/-
„ fdry. No. 3*	75/-
Derbyshire forge*	73/6
„ fdry. No. 3*	78/6
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	80/6
„ No. 3	78/-
Hem. M/Nos.	81/-
Sheffield (d/d district)—	
Derby forge	67/6
„ fdry. No. 3	72/6
Lincs. forge.	70/-
„ fdry No. 3	75/-
E.C. hematite	89/-
W.C. hematite	90/-
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	72/-
„ fdry. No. 3	77/-
Staffs foundry No. 3	77/-
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	95/-
Glengarnock, No. 3	—
Gartsherrie, No. 3	95/-
Monkland, No. 3	95/-
Shotts, No. 3	95/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.		£	s.	d.
Iron—							
Bars (cr.)					10	15	0
Nut and bolt iron	9	0	0	to	9	7	6
Hoops					10	15	0
Marked bars (Staffs) f.o.t.					12	10	0
Gas strip					10	15	0
Bolts and nuts, ¾ in. × 4 in.					15	5	0
Steel—							
Ship plates	8	15	0	to	8	17	6
Boiler plts.	9	17	6	to	10	10	0
Chequer plts.					10	12	6
Angles					8	7	6
Tees					9	7	6
Joists					8	10	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¾ in. (Untested)					8	2	6
					and upwards		
Flats—8 in. wide and over					8	12	6
„ under 8 in. and over 5 in.					8	17	6
Rails, heavy					8	10	0
Fishplates					12	0	0
Hoops (Staffs)	9	5	0	to	9	15	0
Black sheets, 24 g.					9	15	0
Galv.cor.shts., 24g.	11	17	6	to	12	2	6
Galv. fencing wire, 8g. plain					12	0	0
Billets, soft	6	0	0	to	6	10	0
Billets, hard	7	10	0	to	8	0	0
Sheet bars	5	15	0	to	6	5	0
Tin bars	5	15	0	to	6	5	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/2
Sheet to 10 w.g.	1/2½
Wire	1/3¾
Rods	1/3
Tubes	1/7½
Castings	1/2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3⅝ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.00
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80%	94.00
O.-h. rails, h'y, at mill	43.00
Billets	33.00
Sheet bars	33.00
Wire rods	38.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.75
Tank plates	1.75
Beams, etc.	1.75
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.55
Sheets, galv., No. 24	3.30
Sheets, blue an'l'd, No. 13	2.15
Wire nails	2.15
Plain wire	2.40
Barbed wire, galv.	2.95
Tinplates, 100-lb. box	$5.25

COKE (at ovens).

Welsh foundry	27/6
„ furnace	17/6 to 22/6
Durham and Northumberland—	
„ foundry	15/6
„ furnace	15/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	18/4½
„	28×20 „	36/9
„	20×10 „	26/4½
„	18¾×14 „	19/1½
C.W.	20×14 „	16 6
„	28×20 „	33/9
„	20×10 „	23/6
„	18¾×14 „	17/-
Terneplates	28×20	32/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-Iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, steel	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ¼ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water ..	58½%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
May	1 ..	50	15	0	inc.	7/6
,,	2 ..	51	0	0	,,	5/–
,,	5 ..	49	10	0	dec.	30/–
,,	6 ..	48	10	0	,,	20/–
,,	7 ..	48	7	6	,,	2/6

Electrolytic Copper.

		£	s.	d.		
May	1 ..	60	0	0	dec.	40/–
,,	2 ..	60	0	0	No change	
,,	5 ..	59	0	0	dec.	20/–
,,	6 ..	58	0	0	,,	20/–
,,	7 ..	56	0	0	,,	40/–

Standard Tin (cash).

		£	s.	d.		
May	1 ..	151	10	0	dec.	30/–
,,	2 ..	150	5	0	,,	25/–
,,	5 ..	148	15	0	,,	30/–
,,	6 ..	142	7	6	,,	127/6
,,	7 ..	145	5	0	inc.	57/6

Tin (English ingots).

		£	s.	d.		
May	1 ..	152	10	0	dec.	30/–
,,	2 ..	151	5	0	,,	25/–
,,	5 ..	149	15	0	,,	30/–
,,	6 ..	143	10	0	,,	125/–
,,	7 ..	146	5	0	inc.	55/–

Zinc Sheets (English).

		£	s.	d.		
May	1 ..	27	10	0	No change	
,,	2 ..	27	10	0	,,	,,
,,	5 ..	27	10	0	,,	,,
,,	6 ..	27	10	0	,,	,,
,,	7 ..	27	10	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
May	1 ..	16	12	6	dec.	5/–
,,	2 ..	16	7	6	,,	5/–
,,	5 ..	16	5	0	,,	2/6
,,	6 ..	16	0	0	,,	5/–
,,	7 ..	16	2	6	inc.	2/6

Lead (English).

		£	s.	d.		
May	1 ..	18	15	0	dec.	10/–
,,	2 ..	18	15	0	No change	
,,	5 ..	18	10	0	dec.	5/–
,,	6 ..	18	10	0	No change	
,,	7 ..	18	15	0	inc.	5/–

AVERAGE MONTHLY PRICES OF WEST COAST HEMATITE MIXED NUMBERS DELIVERED SHEFFIELD.

Year	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Yearly average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1888	44 4	42 3	42 1½	42 0	41 2½	42 1½	42 6½	44 0	45 8½	44 6	44 6	45 3½	43 4
1889	44 4	45 2	47 3½	48 9½	48 6½	48 7½	50 1½	53 11	55 3	63 6	73 10	73 2	54 4½
1890	76 1½	65 1	63 3	55 1	53 9½	50 11	52 3½	56 4	58 0	58 2	57 5	54 4½	58 5
1891	52 9	50 10	48 11	47 9½	51 5	50 6	50 10	48 4	50 1	49 1½	48 3½	47 8	49 8½
1892	47 4	45 6	46 4½	47 8	49 5	50 4½	49 7½	49 10½	49 10½	48 8½	46 10	46 1½	48 2½
1893	46 0½	45 8	45 11	45 7	44 11	44 9½	44 10	45 3	45 0	44 6	44 7	45 8	45 3
1894	45 3	45 3	45 1½	45 1	43 11	43 11	43 9½	44 2	44 7½	43 7	43 5	43 3	44 3½
1895	42 8	42 5½	42 6	42 10	43 10	43 7½	44 10	45 11	49 11	48 9	47 7½	47 7½	45 2½
1896	47 0	48 9	48 9	48 2½	47 3	47 3	46 10	46 10	47 2	48 5	50 7	50 6	48 1½
1897	51 2	49 10	48 5	47 4	47 9½	48 6	47 0	47 3	47 3	47 0	48 3½	47 11	48 2
1898	48 9	48 10	49 4	49 8½	50 10	50 3½	51 0	52 5	53 11	55 8	57 3	56 10	52 1½
1899	59 1	59 9	57 7	59 6	64 7	70 10½	76 7½	72 2	74 3	75 0	78 1½	73 3	68 5
1900	75 3½	76 10	79 10	84 6	81 4	79 1½	83 4	81 5	79 11	76 10	77 8½	68 4	78 8
1901	60 2	59 0	57 9½	57 6½	57 8	57 4½	57 8	61 0	60 0½	59 9	58 7½	56 7	58 7½
1902	56 1	57 9½	59 3½	59 9	59 10½	60 0	60 0	60 8½	61 5	61 2	59 3	59 0	59 6
1903	58 5	58 8	61 1	59 5	57 10	57 3	56 7	56 3	55 9	54 8	52 4	52 4	56 8½
1904	52 8½	53 1	53 7	54 9	54 2	53 2½	52 9	52 5	52 2½	52 7	53 1	55 11½	53 5½
1905	57 9½	56 9	58 1	58 2	56 4	55 8	55 5½	56 7	61 0	68 9	69 9	70 11½	60 5½
1906	70 4½	65 2½	63 4½	63 9	64 5	64 6	64 1	66 2½	67 3	69 4½	72 4½	78 8½	67 5
1907	77 9	72 11	71 10	73 9	79 9½	76 9	77 9	78 4	75 11	72 9½	68 6	66 7	74 4
1908	62 7	59 1	61 6½	61 6½	61 4	59 1	57 9½	56 11	60 2	59 2	58 5½	57 7	59 7½
1909	51 4	56 5	55 3	56 1	56 4	57 0	56 8	58 0	61 0	61 1½	60 7½	61 4	58 1½
1910	64 0½	64 3½	66 10½	67 6½	66 2½	65 4	64 4½	65 6½	65 2	64 10½	64 6	65 6	65 4½
1911	66 9	66 1	64 10	63 1	62 1	62 0	61 2	62 2	62 1	61 1	61 10	64 0	63 1
1912	67 0	67 0	67 0	69 3	71 9½	72 11	75 9½	79 1½	82 2½	85 0	85 3½	86 6	75 9½
1913	86 6	86 6	86 3	85 0	83 6½	80 10½	78 1	76 10½	72 6	71 0	68 0	65 3	78 4½
1914	64 6	65 4½	65 6	64 11½	64 2½	64 0	64 0	68 11½	74 6½	71 0	65 4½	69 9½	66 10½
1915	78 9	100 6	103 1	113 6	111 9	114 0	116 3	115 2½	113 8½	121 1½	131 9½	139 6½	113 3
1916	135 0	135 0	133 4	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	129 2½
1917	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1918	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1919	127 6	127 6	127 6	127 6	180 6	184 3	195 4½	204 6	204 6	204 6	204 6	204 6	174 7
1920	224 9	235 0	245 0	275 0	290 0	295 0	295 0	295 0	295 0	295 0	295 0	280 0	284 11½
1921	263 4	228 4	180 0	180 0	180 0	160 0	160 0	157 6	142 0	128 6	121 0	115 6	167 9½
1922	125 0	117 6	115 0	115 0	115 0	115 0	113 1½	104 0	105 0	105 0	106 3	110 0	112 1
1923	109 0½	116 5½	133 11½	138 3½	134 2	125 0	115 7½	111 9	110 0	110 0	113 11	115 0	119 5½
1924	115 0	115 0	114 4½	112 6	112 6	112 6	111 0	110 0	110 0	105 4½	102 6	102 6	110 3½
1925	102 6	102 6	100 0	98 6	97 6	95 1½	92 6	90 6	88 3	87 0	88 1½	88 9½	94 3½
1926	90 1½	90 0	89 8½	89 0	89 0	89 0	90 2½	91 9	94 0	97 2½	*	*	91 0
1927	95 4½	95 6	96 6	95 6	95 3	94 0	92 10½	91 6	90 6	90 6	90 6	89 6	93 1½
1928	85 0	85 3	85 5	85 0	85 3	84 9	84 0	83 9	84 0	84 0	83 1	82 6	84 4
1929	82 10½	83 6	85 0	86 9	87 0	87 0	87 3	87 2½	87 6	89 6	89 6	89 10½	86 11
1930	91 6	91 6	91 6	90 0	—	—	—	—	—	—	—	—	—

* No prices available.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

LION

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-.

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

AS Assistant Foundry Manager.—Young man (22) desires position; present experience 3 years' practical jobbing, iron foundry, 2 years' college training in analysis of iron and steel, and 8 months drawing office. Assoc. member I.B.F.—Box 510, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

BRASS Foundry Foreman wanted, with experience of intricate work. One used to machine moulding practice and capable of fixing piece rates, and of good organising capacity. Technical knowledge of non-ferrous practice generally desirable.—State age, experience, and wages required, to Box 496, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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